P
2

LIBRARY
NOV 1955

THE PLANT DISEASE REPORTER

Issued By

PLANT DISEASE EPIDEMICS
and
IDENTIFICATION SECTION

AGRICULTURAL RESEARCH SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE

Volume 39 Number 10

October 15, 1955

The Plant Disease Reporter is issued as a service to plant pathologists throughout the United States. It contains reports, summaries, observations, and comments submitted voluntarily by qualified observers. These reports often are in the form of suggestions, queries, and opinions, frequently purely tentative, offered for consideration or discussion rather than as matters of established fact. In accepting and publishing this material the Plant Disease Epidemics and Identification Section serves merely as an informational clearing house. It does not assume responsibility for the subject matter.

THE PLANT DISEASE REPORTER

Issued by

PLANT DISEASE EPIDEMICS AND IDENTIFICATION SECTION

Horticultural Crops Research Branch — Plant Industry Station, Beltsville, Maryland
Volume 39 — October 15, 1955 — Number 10

IN THIS ISSUE

Nematodes: P. N. DROLSOM and E. L. MOORE report studies on the interaction between parasitic nematodes and susceptible and tolerant tobacco varieties, page 703. Systemic phosphates tested by G. B. BERGESON gave very good control of the stem nematode of alfalfa and daffodils, page 705. FIELDS E. CAVENESS and HAROLD J. JENSEN, page 710, report results with various measures for eliminating root-lesion nematodes from Easter lily bulbs used for forcing. IRVING GRANEK describes and illustrates some morphological differences that can be used to distinguish between Heterodera rostochiensis and H. tabacum, page 716.

Virus Diseases: PHILIP BRIERLEY reports transmission of the lilac witches'-broom virus from lilac to Vinca by dodder, page 719. The time of infection by the barley stripe mosaic virus affects symptom expression, yield, and seed infection, according to R. F. ESLICK and M. M. AFANASIEV, page 722. Buds from certain symptomless Kwanzan and Shiro-fungen flowering cherry source trees used as virus test plants produced fruit symptoms on Lambert and Bing cherry trees resembling those of little cherry, according to E. L. REEVES and PHILIP W. CHENEY, page 725. R. M. GILMER reports evidence of the presence of the necrotic ring spot virus in mahaleb seeds imported from Europe, page 727.

Antibiotics: (See also R. M. GILMER and LOUISE T. DOSDALL below): DONALD M. COE obtained significant control of cucumber downy mildew with streptomycin and also noticed an additive effect with copper, page 729. For control of angular leaf spot of cucumber S. P. DOOLITTLE and F. S. BEECHER found that streptomycin at 400 ppm was more effective than lower concentrations or than copper, page 731.

Vegetable Diseases: E. A. RILEY, page 737, reports occurrence of late blight on potato and tomato in Northern Rhodesia. ROBERT H. DAINES summarizes sweetpotato scurf control studies in New Jersey, page 739. Southern blight and Fusarium bulb rot were unusually prevalent on shallots in Louisiana this year, according to E. C. TIMS, page 746. EMIL F. GUBA discusses the identity of the parsnip leaf spot fungus, page 747.

JOHN R. HARDISON reports occurrence of crown wart of Lotus uliginosus in Oregon, page 749.

Cereals and Grasses: A strain of Xanthomonas translucens var. undulosa isolated from two weedy bromes in Nebraska is only weakly pathogenic to wheat, barley, and rye, according to M. G. BOOSALIS, page 751. NADER G. VAKILI and JOHN F. SCHAFER report an interesting association between infection by downy mildew and occurrence of anthracnose lesions on leaves of oats in Indiana, page 755.

Results of seed treatment tests with pearl millet, Sudan grass, and browntop millet in Georgia are reported by E. S. LUTTRELL et al., page 756.

Fruit Diseases: Of materials tested in New York a combination of Actidione and sulfur gave outstanding control of both powdery mildew and leaf spot on cherry nursery stock, according to R. M. GILMER, page 762. EMIL F. GUBA reviews the history of the Fusicoccum peach canker, page 771.

Special Crops: ALBERT L. SMITH et al. report distribution of crinkle leaf (manganese toxicity) of cotton in Alabama and some other States, page 773. Reaction of kenaf breeding materials to races of the anthracnose fungus are reported by JAMES B. PATE and THOMAS E. SUMMERS, page 776.

Trees and Ornamentals: Of various materials tested to control root rot and soft rot in calla rhizomes in Minnesota peracetic acid gave best results according to LOUISE T. DOSDALL, page 779. CHARLES J. GOULD et al., report the presence of the European rhododendron rust in the United States, page 781. The number of infected trees found this year and the pattern of spread noted suggests that oak wilt is a more immediate threat in some parts of West Virginia than had been thought, according to WILLIAM H. GILLESPIE and R. P. TRUE, page 783.

R. CIFERRI contributes a preliminary list of noteworthy diseases of cultivated plants in continental Eastern China, page 785.

A correction, page 793. Results of the 1954 fungicide tests, page 793. Committee on the history of plant pathology, page 793. August weather, page 794. Manuscripts for the Reporter, page 795.

THE INTERACTION OF CERTAIN TOBACCO VARIETIES AND PLANT PARASITIC NEMATODES

P. N. Drolsom and E. L. Moore[1]

Dixie Bright 101, a disease resistant tobacco variety of recent origin (4), has been planted extensively in North Carolina since 1949. During this same period, a number of plant parasitic nematodes have been recognized as economically important pests of tobacco (2, 3). Beginning in 1952, it was noted that Dixie Bright 101 plants were stunted in some fields where those of certain old established varieties grew normally. Further observations during 1953 indicated that parasitic nematodes were the cause of this disparity in growth.

In 1954 efforts were made to determine the nematode involved in the stunting. In six fields observed Dixie Bright 101 was stunted, whereas intermixed plants of what appeared to be old established varieties grew vigorously. Soil and root samples were collected and processed by the Christie and Perry technique (1) for estimates of nematode populations. Pratylenchus spp. and Tylenchorhynchus claytoni Steiner were the principal plant parasitic nematodes found, the former in all 6 fields, the latter in 4. The data in Table 1 show that the populations of Pratylenchus found on stunted Dixie Bright 101 plants were consistently low. In contrast, the vigorous plants of established varieties supported higher populations. In fields where they were present population levels of T. claytoni were equally as high on Dixie Bright 101 as on other varieties.

Table 1. Average number of Pratylenchus spp. per 2 grams of roots and of Tylenchorhynchus claytoni per 1 pint of soil from 6 tobacco fields where Dixie Bright 101 and other varieties were grown in the same field.

Field	Dixie Bright 101			Other variety		
	Number samples	Number nematodes		Number samples	Number nematodes	
		Range	Average		Range	Average
			Pratylenchus spp.			
1	15	0-160	70	2	960-1860	1410
2	5	0-80	38	2	140-200	170
3	4	20-200	100	2	180-540	360
4	9	0-100	40	10	0-1420	882
5	4	0-480	220	1	-	960
6	3	120-200	167	1	-	780
			Tylenchorhynchus claytoni			
2	5	30-650	376	2	0-340	170
3	4	250-1010	695	2	620-1140	880
4	9	0-910	160	10	0-620	115
6	3	510-860	677	1	-	320

Pratylenchus spp. and T. claytoni cause severe stunting of Dixie Bright 101 plants. The relatively low numbers of the former necessary to cause stunting indicates an extreme sensitivity, which probably is a limiting factor in population buildup. Although low numbers of T. claytoni caused stunting, this nematode appeared to multiply on Dixie Bright 101 equally as well as on other varieties. The old established varieties undoubtedly have been grown and

[1] Respectively, Associate Pathologist, Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture; and Research Associate Professor, North Carolina State College, Raleigh, North Carolina and Senior Agronomist, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

selected on nematode-infested soil over a long period of time, and apparently a tolerance to certain parasitic nematodes has been built up in these varieties which is not present in the more recently developed variety, Dixie Bright 101.

Literature Cited

1. Christie, J. R., and V. G. Perry. 1951. Removing nematodes from soil. Proc. Helminth. Soc. of Washington 18 (2): 106-108.
2. Graham, T. W. 1951. Nematode root rot of tobacco and other plants. South Carolina Agr. Exp. Sta. Bul. 390.
3. _____. 1954. The tobacco stunt nematode in South Carolina. (Abst.) Phytopathology 44: 332.
4. Moore, E. L., G. B. Lucas, and E. E. Clayton. 1952. Granville wilt and black shank resistant tobacco varieties. North Carolina Agr. Exp. Sta. Bul. 378.

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, AND PLANT PATHOLOGY, NORTH CAROLINA STATE COLLEGE, RALEIGH, NORTH CAROLINA

THE USE OF SYSTEMIC PHOSPHATES FOR CONTROL OF DITYLENCHUS DIPSACI ON ALFALFA AND DAFFODILS

G. B. Bergeson[1]

Summary

Highly significant control of Ditylenchus dipsaci on daffodils and alfalfa in greenhouse tests was obtained with the use of OS1836 (diethyl 1-chlorovinyl phosphate) on alfalfa and on daffodils with Systox and OS1836. In experiments with alfalfa drench and spray applications were approximately equal in effectiveness. Three spray applications were necessary to obtain complete control. In the case of daffodils nearly 100 percent control was obtained by applying Systox and OS1836 as a drench at concentrations as low as 0.1%. This degree of control was achieved within 1 week following treatment with OS1836 and within 4 weeks following treatment with Systox. Some phytotoxicity was observed with both OS1836 and Systox at 1.0% and 0.5% concentrations. OMPA gave substantial control but did not consistently approach the control obtained with Systox and OS1836. OMPA was not phytotoxtic at any of the concentrations used.

Since the advent of systemic phosphates, several papers have appeared in the literature relating the use of these materials as nematocides. Feder (1) reported that he obtained 100 percent control of Ditylenchus dipsaci (Kuehn 1858) in the leaves and 93 percent control in the bulbs of daffodils by applying a Systox drench around the base of the plants. Spraying the plants with Systox, according to his report, was slightly less effective. Sasser (2) has reported substantial reduction of root knot nematode on tomatoes and cucumbers by using Systox drenches on infested plants; however, to obtain 100 percent control the required concentration was too phytotoxic for use. Sher and Kamaski (3) compared several phosphates in attempting to control Aphelenchoides besseyi on Vanda orchids. They reported 100 percent control in field tests with OS1836 (diethyl 1-chlorovinyl phosphate), a Shell experimental insecticide, methyl parathion, and Systox.

The purpose of this paper is to report additional information regarding the use of systemic phosphates on daffodils and alfalfa. The experiments with these host plants were conducted separately with slightly different objectives and they are reported separately.

OS1836 FOR CONTROL OF DITYLENCHUS DIPSACI ON ALFALFA

Ditylenchus dipsaci infestation on alfalfa is becoming an increasingly serious problem in certain cool humid areas of California. Control at the present time is a matter of either crop rotation or the planting of two reportedly resistant varieties, Nemastan and Lahonton. Neither of these two methods is of immediate value to a grower whose young alfalfa field is showing the reduced growth and premature die-out associated with heavy infestations of D. dipsaci. A nematocidal material which could be applied to the growing alfalfa would be ideal for this type of situation. The possibilities of this type of control have increased considerably with the discovery of systemic insecticides which readily translocate to all the foliar portion of the plant. A property such as this would be of special value in controlling foliar nematodes such as D. dipsaci. One such systemic, OS1836, was selected for small pot tests conducted under greenhouse conditions.

The first series of tests were conducted to determine the comparative effectiveness of a drench application versus a spray application. This was done by spraying a series of infected alfalfa seedlings growing in 4-inch clay pots with concentrations of 0.2%, 0.1%, and 0.05% of OS1836 formulated as a 20% concentrate in acetone containing a 5% Triton X-100 emulsifier. A duplicate set of potted alfalfa seedlings received the same quantity of chemical applied as a drench around the base of the seedlings. Each treatment was replicated five times and one set of five pots was left untreated to serve as the control. One and 2 weeks after treatment, bud samples were taken and chopped in a food blender and the nematodes recovered by screening. Results of these examinations appear in Table 1.

On the basis of the data in Table 1 there appeared to be no distinct superiority of one application method over the other. All treatments gave highly significant reductions in the total number of nematodes present 2 weeks after treatment. Figure 1 shows growth increases of the

---

[1] Senior Laboratory Technician, Department of Plant Nematology, University of California.

FIGURE 1. Comparison of growth between plants sprayed with OS 1836 and untreated plant.

Table 1. Comparison between spray and drench methods of applying OS1836 for control of Ditylenchus dipsaci in alfalfa; amount applied 40 cc each treatment.

Method of application	Concentration (%)	1 week after treatment: Nemas per gram of bud	1 week after treatment: Condition of nematodes	2 weeks after treatment: Nemas per gram of bud	2 weeks after treatment: Condition of nematodes
Spray	0.2	4,464	Inactive	480	Apparently dead
	0.1	2,125	A few slightly active	720	A few slightly active
	0.05	4,800	Most nemas slightly active	640	33% active
Drench	0.2	3,036	A few slightly active	225	A few slightly active
	0.1	1,812	Several slightly active	315	Several slightly active
	0.05	3,779	Most nemas slightly active	687	Several active
Control		8,571	Almost all actively moving	9,000	Almost all actively moving

Table 2. Comparison between number of spray applications of OS1836 for control of Ditylenchus dipsaci.

Number of applications	Nemas per gram of foliage	Total green weight (gm)
3	0	25.0
2	8.2	24.2
1	13.0	23.1
Control	41.0	19.1

treated plants over the untreated. The 0.2% concentration was somewhat phytotoxic and consequently does not show growth increases equal to that of the next lower concentration.

Mortality determinations of the nematodes remaining in the tissues after 2 weeks were very difficult and often uncertain. To check these determinations the material from which the counts were made was used to inoculate pots that were subsequently planted to alfalfa. Several weeks later an examination of the inoculated alfalfa plants showed them all to be infected to varying degrees. From this one might conclude either that some of the moribund nematodes recovered successfully or that the chemical was not killing the egg stage of the nematode. Whatever the reason, it was apparent that one application was not sufficient for complete control.

A second series of tests was conducted in much the same manner to determine the benefits of repeated sprayings. Infected alfalfa seedlings were divided into 3 lots of 4 pots each. A 0.1% concentration of OS1836 formulated as before was used throughout. This concentration was chosen because it represents the highest concentration that did not show phytotoxicity to the alfalfa. The first lot of pots received one spraying, the second lot received two sprayings at weekly intervals, and the third lot received three sprayings at weekly intervals. A fourth lot of pots was left untreated and served as a control. One month was allowed to elapse before examinations were made in order to allow eggs to hatch and to aid in distinguishing between dead and living nematodes. At the end of this period the foliar portion of the alfalfa plant was cut and weighed. After weighing, the stems and leaves were chopped in a food blendor and counts of the nematodes present were made. These data appear in Table 2.

Results in Table 2 indicate that at least three spray applications are necessary for eradication and that increased yields were obtained with a reduction in the nematode population.

COMPARISON OF DIFFERENT SYSTEMIC PHOSPHATES FOR CONTROL OF DITYLENCHUS DIPSACI ON DAFFODILS AND ALFALFA

In both Feder's (1) and Sher's (3) experiments, the maximum observation time after treatment for determining the degree of control was 5 and 7 days respectively. It was one of the objectives of this experiment to extend this period of observation up to 28 days. Another objective was to include the two most effective systemics reported for direct comparison in the same experiment. Because OMPA (octamethyl pyrophosphoramide) was not reported in any of the literature examined by the author, it too was included for comparative purposes.

Materials and Methods: Ninety infected daffodil plants growing in 6-inch clay pots were selected for this experiment. These were divided into 10 lots of 9 pots each. Each chemical was formulated as a 25% concentrate in acetone containing a 5% Triton X-100 emulsifier. Each chemical was then prepared as an aqueous emulsion in concentrations of 1.0%, 0.5%, and 0.1% of the actual ingredient. The treatments were replicated nine times and consisted of a 100 ml. drench per pot of the above concentrations at weekly intervals for a total of 3 weeks. At the end of this period each of the nine pots in each treatment had received a total of 3 ml., 1.5 ml., and 1 ml. of chemical, depending on which series they were in. One lot of nine pots served as the control and received only the water, acetone, and emulsifier. Treatments were conducted

Table 3. Comparison of control of Ditylenchus dipsaci in daffodils obtained by Systox, OMPA, and OS1836, at 1 and 4 weeks after treatment.

Chemical (%)	Bulb				Leaf					
	Nematodes per gram				Nematodes per gram				Percent increase in leaf weight at	
	No. living at		Percent reduction at		No. living at		Percent reduction at			
	1 week[a]	4 weeks[b]	1 week	4 weeks	1 week	4 weeks	1 week	4 weeks	1 week	4 weeks
Control	61.3	139.0	-	-	310.5	6708	-	-	-	-
Systox										
1.0	29.1	0	52.5	100	35	0	88.7	100	13.6	248
0.5	.3	0	99.6	100	.3	0	99.9	100	10.6	283
0.1	56.2	2	8.4	98.6	92.5	0	70.3	100	3	506
OS1836										
1.0	0	0	100	100	0	0	100	100	45.4	145
0.5	0	0	100	100	0	0	100	100	40	109
0.1	0	0	100	100	0	13	100	99.9	186	322
OMPA										
1.0	.2	27.7	99.7	80.1	38.2	548	87.7	91.8	43.9	351
0.5	14.6	240	76.2	0	55.6	119.5	82.1	98.2	78.7	325
0.1	11.3	38.0	81.7	77	53.8	1588	52.7	76.4	113	419

[a]Average of 5 replications.
[b]Average of 4 replications.

in a greenhouse at a temperature of approximately 75° F.

Results were determined by removing five of the nine plants at 1 week, and the remaining four plants at 4 weeks, after the final treatment. Nematode counts were made by weighing bulbs and leaves separately and then placing them in a food blendor for 15 seconds. The nematodes were separated from the plant debris by screening and placed in 100 cc of water from which two 1 cc aliquots were taken and examined in a counting slide. If less than 10 nematodes per 1 cc were found, then two 5 cc aliquots were examined in a counting dish. Results of these examinations are tabulated in Table 3.

Results and Discussion: The results contained in Table 3 confirm the earlier reports of Feder and Sher on the excellent control of foliar nematodes with the use of Systox and OS1836. This test further demonstrated that with Systox the percentage of control increased with time at least up to 4 weeks, whereas OS1836 reached its maximum effectiveness within a week. OMPA, although giving substantial control, did not approach the nearly 100 percent effectiveness of Systox and OS1836.

Both Systox and OS1836 produce phytotoxic symptoms in the form of leaf tip burn at the 1.0% and 0.5% levels, which explains why the percentage increase in leaf weight was less at these than at the 0.1% concentrations. Consequently 0.1% would appear to be the most profitable concentration to use. OMPA, on the other hand, did not appear phytotoxic at any of the concentrations used.

Literature Cited

1. Feder, William A. 1952. Systox for nematodes in daffodils. New York State Flower Growers, Inc. Bull. 82. June 1952.
2. Sasser, J. N. 1952. Studies on control of root-knot nematodes (Meloidogyne sp.) with Systox spray (E-1059) an Organic Phosphate Insecticide. Plant Dis. Reptr. 36: 228-233.
3. Sher, S. A., H. Kamasaki, and H. Murakishi. 1953. Intensive spray controls nematode. Hawaii Farm Science. July.

DEPARTMENT OF PLANT NEMATOLOGY, UNIVERSITY OF CALIFORNIA

ØINVESTIGATIONS OF VARIOUS THERAPEUTIC MEASURES TO ELIMINATE ROOT-LESION NEMATODES FROM EASTER LILIES[1]

Fields E. Caveness and Harold J. Jensen

Abstract

The assumption that lily bulbs used for forcing are sources of root-lesion nematode infection was verified by recovering nematodes from the old root remnants of 92 percent of a 100-bulb random sample from an infested field. However, during forcing no performance differences were noted between infected and non-infected bulbs and the symptoms claimed by forcers to be due to root-lesion nematodes were not apparent. The dissemination of nematode pests in forcing and in field planting stocks is regrettable and several methods of eliminating the nematodes were investigated. The removal of root remnants after cold storage reduced the number of infected bulbs by 84 percent and had no apparent effect on the forcing quality. This treatment was as efficient and less injurious than the hot water soaks, chemical soaks, and vacuum fumigation trials investigated.

Introduction

Two species of root-lesion (meadow) nematodes, Pratylenchus pratensis deMan 1881, and P. penetrans (Cobb) Sher & Allen 1953, have been reported as pests of the Easter lily growing areas of the Pacific Coast; Butterfield 1947 (1), Jensen 1952 (3), Jensen, Caveness, and McWhorter 1955 (4), McWhorter and Anderson 1951 (5), and Steiner 1945 (6). P. penetrans is is the more widespread of the two species.

Premature yellowing of foliage in "target spot" areas of the field during late summer or early fall is suggestive of damage from root-lesion nematodes. The presence of nematodes can be determined by examining the roots or in some instances the soil surrounding the root system. The root systems of severely infected plants are poorly developed with numerous discolored areas or lesions appearing on the roots. Root-lesion nematodes are usually an associate of a root rot complex that involves fungi, bacteria and mites. The latter organisms are believed to be secondary invaders entering the root through various types of wounds. Fungi belonging to the genera Cylindrocarpon, Fusarium, and Rhizoctonia are frequently recovered from the root lesions. Mites and occasionally symphylids are also associated with the deterioration of root systems.

Recently, local growers have received complaints from forcers that many lily bulbs did not respond to forcing because of the nematodes. Symptoms mentioned by forcers were distortion, dwarfing, yellowing, poor root development, and poor flowering. Root-lesion nematodes were found in less than one-half of 50 unthrifty plants sent here from forcing houses across the nation. In several instances the population of these pests in the soil or in the root tissue was so small that they could be found only with difficulty. Although some root-lesion nematodes were recovered from the new roots, most of the infection was observed in the older roots. Further examination of the unthrifty plants revealed that other root rot disease complex organisms were usually present.

In response to these complaints, an investigation was undertaken to determine: (a) the percentage of field-infected bulbs disseminating root-lesion nematodes; (b) whether the symptoms claimed by forcers could be reproduced under experimental conditions; (c) whether therapeutic measures could be used against the nematode pests without injury to the lilies.

Materials and Methods

Croft Easter lily bulbs (#7 commercials) were obtained from field plantings having a history of root-lesion nematode infection. The bulbs were packed in peat as for shipment and held in cold storage at 35° F for a minimum period of 2 months. A random sample of 100 bulbs revealed that 92 percent were infected with root-lesion nematodes. A total of 975 bulbs were used to investigate the following therapeutic measures: (a) hot water soaks, (b) chemical soaks, and (c) vacuum fumigation. Eight bulbs comprised each treated unit. Three bulbs of each unit were

[1] Technical Paper No. 929, Oregon Agricultural Experiment Station.

forced in a greenhouse at Corvallis and the remaining five bulbs were planted in southwest Oregon. The old root remnants were removed from the basal plate of another unit of 25 bulbs. The controls consisted of two units of 25 bulbs. One unit was determined to be 100 percent infected by microscopic examination and the other unit consisted of bulbs from a planting not having a history of infection.

All of the bulbs except those used in vacuum fumigation and chemical soak trials were dipped in Spergon (1 pound of 25% wettable in 5 gallons of water) before planting. The bulbs, except those reserved for vacuum fumigation trials, were planted in November; those treated by vacuum fumigation were planted in January and February. The 425 bulbs retained at Corvallis for forcing studies were planted in #10 cans of autoclaved soil and covered with 1 to 2 inches of sawdust to minimize the danger of contamination and for frost protection. The bulbs were brought into the greenhouse for forcing on December 18. No fertilizers or supplemental lights were used during the forcing period.

HOT WATER SOAKS. The thermal death point of root-lesion nematodes in lily roots and the subsequent effects of heat on the forcing qualities of the bulbs, were studied in the following manner. The bulbs were soaked in a precision hot water treating unit (2) or in a dish pan of water heated by a Bunsen burner for the higher temperatures. The temperatures and exposure periods are listed in Table 1.

CHEMICAL SOAKS of 5- and 30-minute periods are listed for ten materials in Table 2.

VACUUM FUMIGATION TRIALS. Seven materials were used in these trials which involved 72 bulbs. A vacuum chamber of 0.29 cu. ft. was evacuated with a water aspirator. They were fumigated at room temperature although the flask containing the fumigant was immersed in boiling water at the beginning of each trial period to facilitate introducing the gas into the chamber via rubber and glass tubing. The materials, concentrations, and exposure periods are listed in Table 3.

The lily plants were examined after flowering, when the roots were removed and replaced in the original can of soil for population determination by an indicator plant method. Each can of soil and lily roots was seeded to hairy vetch, Vicia villosa Roth., and allowed to grow approximately 60 days. Then the roots of the indicator plants were removed from the soil, comminuted in a Waring blendor, and placed in a Baermann type funnel for a minimum period of 16 hours to recover any root-lesion nematodes present.

Results

Performance data obtained from the unit of 25 bulbs known to be infected indicate that the population of nematodes in the root remnants had little or no effect upon the forcing qualities of the bulbs.

ROOT PRUNING. The removal of the root remnants from 25 bulbs, known to be infected prior to treatment, eliminated the nematodes from 84 percent of the bulbs. There were no apparent adverse effects on the performance of root pruned bulbs that had been held in cold storage. Those planted in commercial plantings were normal.

HOT WATER SOAKS (Table 1). The hot water soak of 128° F for a 10-minute immersion period proved to be the most effective for eliminating the nematodes. The entire series of soaks except the more extreme treatments (above 128° F) appeared to have very little effect upon the forcing qualities of the lilies. The results were far different in the field where many of the soak treatments appeared to be injurious. This indicates that treatments of field planting stocks by such hot water soaks would have to be carefully controlled as many of the treated bulbs planted in the field grew poorly and/or split. Unfortunately, most of the bulbs receiving soaks of 170° and 212° F as well as those receiving chemical soaks were destroyed by gophers in the field.

CHEMICAL SOAKS (Table 2). At the concentrations used, the materials included in the investigation proved to be phytotoxic or ineffective in controlling nematodes. Although this method may eventually prove to be the more practical as well as economical, the phytotoxic nature of the materials and their inability to penetrate roots must be overcome. Oil and water soluble red dyes were used to observe root penetration. Prolonged soaking of bulbs in oil or

Table 1. The average number of root-lesion nematodes (Pratylenchus penetrans) recovered from Easter lily roots after treatment by hot water.

Temperature	Period of Exposure	No. of Nematodes Recovered per Plant*	Greenhouse Observation	Field Observation
104°F	1 hr	900	Normal ***	Normal
	2 hrs	650	Normal	Normal
	3 hrs	775	Normal	Normal
	4 hrs	900	Normal	Slight dwarfing
	5 hrs	700	Normal	Slight dwarfing
	6 hrs	625	Normal	Slight dwarfing
	10 hrs	425	Normal	Slight dwarfing
108°F	1 hr	850	Normal	Normal
	2 hrs	125	Normal	Normal
	3 hrs	275	Normal	Normal
	4 hrs	650	Normal	Slight dwarfing
	5 hrs	125	Normal	Slight dwarfing
	6 hrs	33	Slight dwarfing	Slight dwarfing
	10 hrs	375	Slight dwarfing	Slight dwarfing
110°F	5 min	325	Normal	Normal
	10 min	300	Normal	Normal
	20 min	300	Normal	Slight dwarfing
	40 min	550	Normal	Slight dwarfing
	1 hr	1100	Normal	Slight dwarfing
	1.5 hrs	150	Normal	Slight dwarfing
	2 hrs	825	Normal	Slight dwarfing
	3 hrs	525	Normal	Slight dwarfing
112°F	5 min	425	Normal	Normal
	10 min	350	Normal	Normal
	20 min	425	Normal	Normal
	40 min	200	Normal	Normal
	1 hr	225	Normal	Normal
	1.5 hrs	125	Normal	Slight dwarfing
	2 hrs	350	Normal	Slight dwarfing
	3 hrs	100	Normal	Slight dwarfing
114°F	5 min	250	Normal	Normal
	10 min	225	Normal	Normal
	20 min	325	Normal	Normal
	40 min	200	Normal	Normal
	1 hr	150	Normal	Normal
	1.5 hrs	125	Normal	Slight dwarfing
118°F	5 min	200	Normal	Normal
	10 min	275	Normal	Slight dwarfing
	20 min	275	Normal	Slight dwarfing
	40 min	17	Normal	Slight dwarfing
128°F	5 min	25	Normal	Slight dwarfing
	10 min	0	Normal	Slight dwarfing
	20 min	0	Normal	Slight dwarfing
170°F	5 min	0	Slight dwarfing	Destroyed by
	10 min	0	Phytotoxic	Gophers
	20 min	0	Phytotoxic	
212°F	5 sec	42	Slight dwarfing	Destroyed by
	10 sec	0	Slight dwarfing	Gophers
	15 sec	0	Slight dwarfing	
	20 sec	25	Slight dwarfing	
	30 sec	0	Slight dwarfing	
	40 sec	17	Slight dwarfing	
	50 sec	0	Slight dwarfing	
	60 sec	8	Slight dwarfing	
	120 sec	0	Phytotoxic	
	180 sec	0	Phytotoxic	
	240 sec	0	Phytotoxic	
	300 sec	0	Phytotoxic	
Control		600**		Normal

* Average of three replications.
** Average of ten replications.
*** Normal in respect to the control plants, i.e., approximately 35 cm in height and producing 1-3 blossoms.

Table 2. The average number of root-lesion nematodes (Pratylenchus penetrans) recovered from Easter lily roots after treatment by chemical soaks.

Chemical	Per Cent Concentration	Period of treatment and number of nematodes recovered per plant* 5 Minutes	30 Minutes	Plant Response
Systox 42% (ethyl mercaptoethyl diethyl thiophosphate)	20	0	0	Phytotoxic
AC 14 (not disclosed)	1	0	0	Phytotoxic
Gentian violet	1	0	0	Phytotoxic
Phenol	1	0	0	Phytotoxic
1197 (not disclosed)	100	0	0	Phytotoxic
339 (not disclosed)	5	100	160	Normal**
EDB (ethylene-dibromide)	100	0	0	Phytotoxic
CBP (Chlorobromopropene)	100	0	0	Phytotoxic
DD (Dichloropropene-dichloropropane)	100	0	0	Phytotoxic
PN 1414 (Ethylisothiocyanate)	1	0	0	Phytotoxic
NP 1093 (1,4-dichloro 2-butyne) & NP 1353 (not disclosed)	1	25	60	Slight dwarfing
Control		150	475	Normal

* Average of three applications.
** Normal in respect to the control plants, i.e. approximately 35 cm in height and producing 1-3 blossoms

Table 3. The average number of root-lesions (Pratylenchus penetrans) recovered from Easter lily roots after various periods of vacuum fumigation.

Fumigant	Concentration of active ingredients lbs/1000 cu. ft.	Nematodes recovered from each period of exposure per plant* 2 hrs.	7 hrs.	15 hrs.	Plant response
EDB (ethylene-dibromide)	50	17	42	0	Normal **
EDC (ethylene-dichloride)	47	150	0	17	Slight dwarfing
CBP (chlorobromopropene)	50	33	0	0	Normal
Allyl bromide	55	0	0	0	Phytotoxic
DD (dichloropropene-dichloropropane)	50	0	0	0	Phytotoxic or Slight dwarfing
Formaldehyde	34	80	17	0	Normal
PW 1414 (ethylisothiocyanate)	38	0	8	0	Slight dwarfing above 2 hrs. exposure
Control		400 (average of 7 replications)			

* Average of three applications.
** Normal in respect to the control plants, i.e., approximately 35 cm in height and producing 1-3 blossoms.

water soluble dyes in open vessels or under vacuum indicated that the roots were not penetrated except in small localized areas near wounds or broken ends of roots.

VACUUM FUMIGATION (Table 3). The vapors of the seven materials introduced into a vacuum chamber proved to be phytotoxic in most instances. However, three materials (CBP, Formaldehyde, and PN 1414) were non-injurious or only slightly so and gave a noticeable reduction in the population of nematodes.

Discussion

The recovery of surviving nematodes by teasing apart the treated tissues in water and observing the debris for active nematodes over an interval of several days proved to be inefficient when compared with the more laborious indicator plant method. It is a mistake to conclude that all of the nematodes are eliminated because no active nematodes are observed. Apparently the egg stage is able to survive more adverse conditions than larvae or adult nematodes. This was apparent when the authors were unable to find active nematodes in the debris of the comminuted tissues from sub-lethal hot water treatments. Thus, the time-consuming laborious use of an indicator plant for determining the existing root-lesion nematode population has the following advantage: (a) attraction from the soil, (b) determination of viability, and (c) stimulation of egg hatching.

The presence of root-lesion nematodes in the old roots of lilies at the time of potting failed to lead to the symptoms of poor growth that forcers attributed to nematodes. A probable explanation of this phenomenon is that the basal and stem root systems of lily plants grow at a rate during forcing far surpassing the destructive potential of the nematodes. Forcing is completed before the nematodes have migrated into the potting soil in sufficient numbers to impair root development. Examination of the root system of infected bulbs shortly before forcing was completed indicated that the major portion of the nematode population was still in the old roots. Since the old roots have little to do with the growth of salable flowers, the bulbs forced well.

The presence of large populations of nematodes in the lily potting soil would probably lead to a different situation where the developing roots would be directly exposed to infection. This situation would be comparable to the growing of lilies in infested fields, and illustrates the need for some form of efficient sterilization of potting soils in many areas where lilies are forced.

The dissemination of root-lesion nematodes in the roots of lily bulbs is undesirable, and soil fumigation is being investigated as a means of cleaning up infested areas in field plantings.

Literature Cited

1. Butterfield, H. M. 1947. Production of Easter lily bulbs. Calif. Agr. Ext. Ser. Air 132.
2. Griffiths, D. 1930. Experiments with hot-water treatment of daffodils in relation to forcing and field culture. U. S. Dept. Agr. Circular No. 113. pp 7-12.
3. Jensen, H. J. 1952. Nematode root rots of narcissus and lilies. Proc. 1952. Bulb Growers Short Course. pp. 52-54.
4. _____, Caveness, F. E., and McWhorter, F. P. 1955. Root lesion nematodes and the forcing of Easter lilies. Florists Review 115 (2994): 31 (April).
5. McWhorter, F. P. and J. Anderson. 1951. Diseases in Croft lily plantings. 1949-50. Plant Dis. Reptr. 35: 106-108.
6. Steiner, G. 1945. Meadow nematodes (Pratylenchus sp.) as the cause of root destruction. Phytopath. 35: 935-937.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, OREGON

ADDITIONAL MORPHOLOGICAL DIFFERENCES BETWEEN THE CYSTS OF HETERODERA ROSTOCHIENSIS AND HETERODERA TABACUM

Irving Granek[1]

Six means of differentiating between the golden nematode of potatoes, Heterodera rostochiensis Wollenweber, 1923, and the tobacco cyst nematode, H. tabacum Lownsbery & Lownsbery, 1954[2], were mentioned in the original description of the latter species. Four of these are based on male or larval characters, one on host tests, and one on a cyst character. Since these means require a highly trained technician or are time consuming, it was found that there was a need for additional cyst characters for readily separating these two species. The cyst character that the Lownsberys use to differentiate between these two species is based on the arrangement of the cuticular punctation. As they state, the punctation is rarely visible. A search therefore was made for additional characters.

One hundred golden nematode cysts from Long Island potato fields and 100 tobacco cyst nematodes from Connecticut shade tobacco fields were prepared for observation and measurements. Cysts for measuring were cut at right angles to the longitudinal axis and the posterior portion placed with the cut edges in contact with the slide. Particular attention was paid to the vulva-anal area, as there appeared to be a difference in the sizes of the vulvar openings and the distances between the anus and vulva.

When the females of Heterodera rostochiensis and H. tabacum become transformed into cysts the lips of the vulva apparently disintegrate, leaving a more or less distinct opening as shown in Figure 1. It is this opening that was measured. Since the vulva is located at a thin spot on the cyst the opening may appear much larger than its true size when seen by transmitted light, as shown in Figure 2. Careful focusing was necessary to determine the true limits of the opening left by the disintegration of the lips of the vulva, but this could nearly always be done with sufficient precision to permit calculation of the ratio:

$$\frac{\text{Distance from anus to nearest edge of vulva opening}}{\text{Diameter of vulva opening}} = \frac{B}{A} \quad \text{(Fig. 1)}$$

In Heterodera rostochiensis the distance from the anus to the nearest edge of the vulva opening was found to average 4.6 times the diameter of the vulva, with a range of 2.7 to 8.9. In 97 percent of the cases this ratio was more than 3.0. In H. tabacum the distance from the anus to the nearest edge of the vulva opening was found to average 1.5 times the diameter of the vulva, with a range of 0.9 to 2.8. In 93 percent of the cases this ratio was below 2.0. The data were analyzed using a t test and the differences were found to be highly significant.

GOLDEN NEMATODE CONTROL PROJECT, PLANT PEST CONTROL BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, HICKSVILLE, LONG ISLAND, NEW YORK

---

[1] Laboratory Supervisor, Golden Nematode Control Project, Plant Pest Control Branch, Agricultural Research Service, U. S. Department of Agriculture.

[2] Lownsbery, B. F., and J. W. Lownsbery. 1954. Heterodera tabacum new species, A Parasite of Solanaceous Plants in Connecticut. Proc. Helm. Soc. Wash. 21: 42-47.

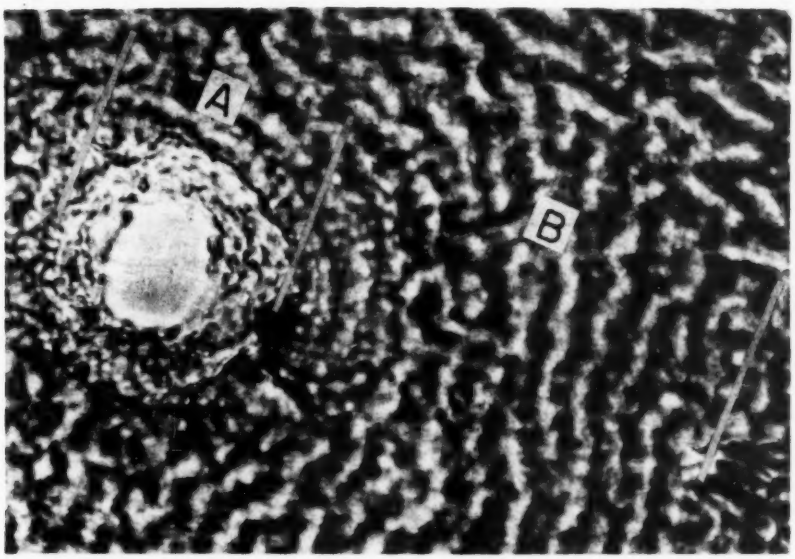


FIGURE 1. A is the diameter measurement of the vulva opening. B is the distance measurement between vulva opening and anus.

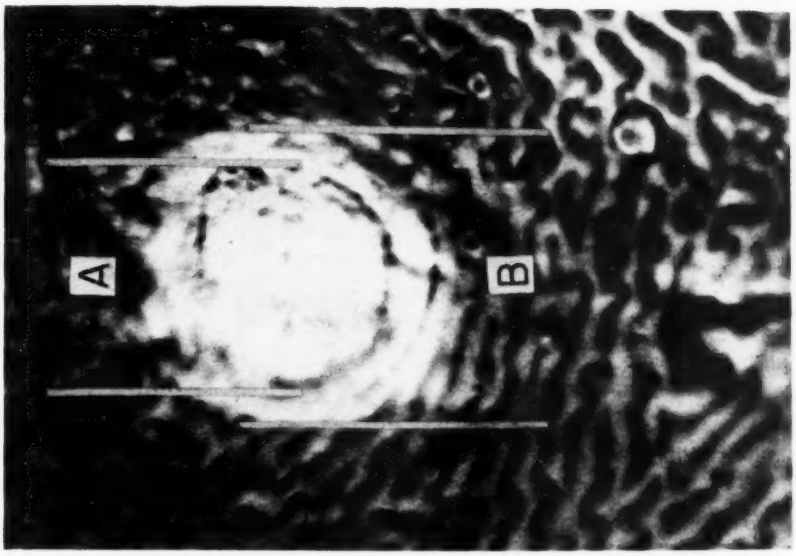


FIGURE 2. A is the actual opening as seen by careful focusing. B is the apparent opening as seen by transmitted light.

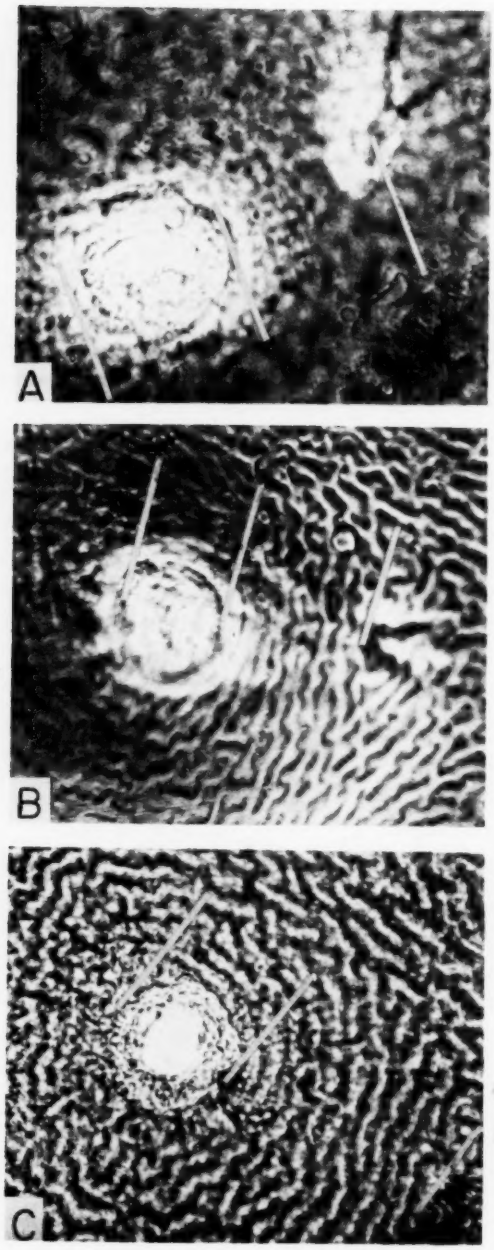


FIGURE 3. H. tabacum
A-Low range ratio approx. 1.0
B-Average range ratio approx. 1.4
C-High range ratio approx. 1.9
(Fig. 4C x450. All others x675)

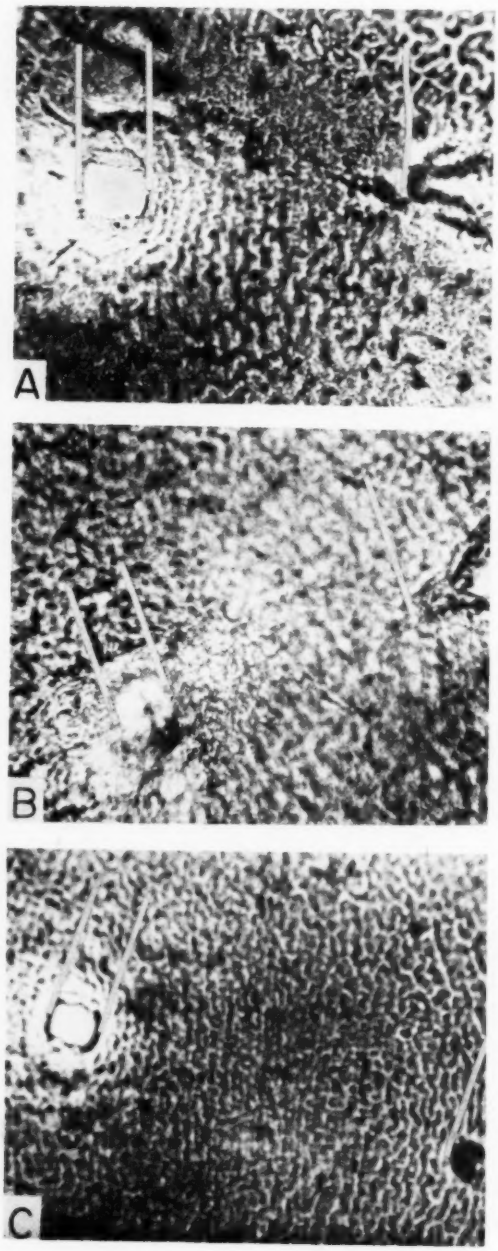


FIGURE 4. H. rostochiensis
A-Low range ratio approx. 3.1
B-Average range ratio approx. 4.2
C-High range ratio approx. 7.2

DODDER TRANSMISSION OF LILAC WITCHES'-BROOM VIRUS

Philip Brierley[1]

The lilac witches'-broom virus is graft-transmissible from lilac to lilac and from Vinca rosea L. to Vinca; it is also transmissible from lilac to Vinca by two species of dodder, Cuscuta campestris Yuncker and C. subinclusa Dur. & Hilg.; no other host plants are known.

FIGURE 1. Lilac witches'-broom in Vinca rosea. Broomed scion after 3 months on normal stock (5-inch pot).

[1] Pathologist, Horticultural Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, Beltsville, Maryland.

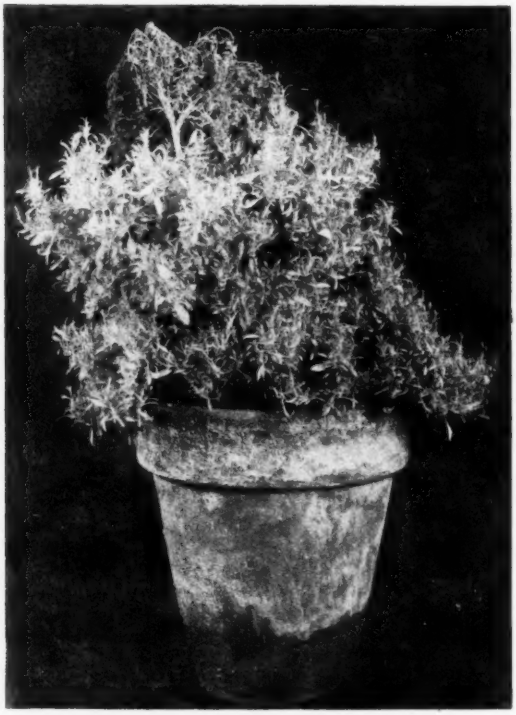


FIGURE 2. Lilac witches'-broom on Vinca rosea after 11 months; Scion dead, stock broomed (5-inch pot). Photographs by Otis Greeson.

As reported previously (1, 2) lilac witches'-broom virus, originally found in Syringa amurensis var. japonica (Maxim.) Franch. f. Sav. in Maryland, is graft-transmissible to the common lilac, S. vulgaris L. Attempts to infect Fraxinus pennsylvanica Marsh. and Forsythia suspensa Vahl by grafting with affected scions of Japanese lilac failed to induce any symptoms. Broomed scions of this lilac on Ligustrum lucidum Ait. survived for 3 years but induced no symptoms in the privet stock. Similar scions on L. obtusifolium var. regelianum (Koehne) Rehd. induced local vein-clearing but no further response, indicating that the privets were uninfected rather than symptomless carriers.

Cuscuta campestris, trained from broomed Japanese lilac to Vinca rosea, induced brooming in Vinca after 1 month or longer. No response was produced in Nicotiana rustica L. or in China aster (Callistephus chinensis (L.) Nees) exposed in like manner. Cuscuta subinclusa also transmitted the brooming virus to Vinca. The reaction of Vinca was a compact and dense witches'-broom with many thin shoots and very small leaves. Small affected plants of Vinca died back from the top downward 2 months after infection; some larger plants died several months later. No other pathogen was found associated with this die-back, and no dieback appeared in healthy Vinca or in plants affected with western aster yellows for 2 years.

The lilac witches'-broom virus is also graft-transmissible from Vinca to Vinca (Figures 1 and 2). A scion of broomed Vinca, infected by means of C. subinclusa, was grafted on healthy Vinca in August, 1954. Figure 1, photographed in November, shows the broomed scion well developed on the symptomless stock. Two weeks later symptoms appeared in the understock and the scion began to wilt, dying back to the graft union. Subsequently the stock developed the dense compact broom shown in Figure 2, photographed 11 months after graft inoculation.

Literature Cited

1. Brierley, Philip. 1951. A witches'-broom of lilac. Plant Dis. Reptr. 35: 556.
2. Lorentz, Paul, and Philip Brierley. 1953. Graft transmission of lilac witches'-broom virus. Plant Dis. Reptr. 37: 555.

HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

INFLUENCE OF TIME OF INFECTION WITH BARLEY STRIPE MOSAIC ON SYMPTOMS, PLANT YIELD, AND SEED INFECTION OF BARLEY[1]

R. F. Eslick and M. M. Afanasiev[2]

SUMMARY

Nursery plots of two varieties of barley, Titan and Compana, were planted May 10 and inoculated with barley stripe mosaic at ten-day intervals from planting till maturity at Bozeman, Montana, in 1954.

Early inoculations resulted in few plants showing symptoms in the field, but assays showed that the virus was present in the seed from plants not showing symptoms. Inoculations after June 10 resulted in symptom expression by all plants.

Yield reduction was most marked from inoculations made one to three weeks before heading.

Seed-borne stripe mosaic was induced to the greatest extent when inoculations were made ten days previous to heading.

McKinney (3) and Eslick (1) reported that barley stripe mosaic is seed borne. McKinney suggested (4) that either all the seeds from an infected plant do not carry sufficient virus into the next generation to result in seedling symptom expression or that the virus does not enter all embryos of a plant. He reported also that brisk air movement that caused some abrasion of leaf tissues resulted in 100 percent transfer of the virus from diseased to healthy plants. Gold, et al (2) determined that barley stripe mosaic could be transmitted by pollen. General observations seem to indicate that perhaps environment and/or time of inoculation would influence the amount of seed borne stripe mosaic.

EXPERIMENTAL PROCEDURE

Two varieties of barley, Titan and Compana, were planted in the field at Bozeman, Montana on May 10, 1954. Each plot consisted of 20 seeds of a variety placed one foot apart between solid drilled rows of oats. Some plants emerged within a week and others about two weeks after planting. Plants from the two dates of emergence were staked and observed separately throughout the test, but since no consistent differences were noted, the data for the two dates of emergence are combined. On May 20, plants in one plot of Compana and one plot of Titan were inoculated with barley stripe mosaic by the carborundum leaf wiping method. Other plots were inoculated at ten-day intervals up to August 10, when the barley was in the hard dough stage. A composite of infected seedling leaves from plantings of Glacier, Oderbrucker, and Compana seed made two weeks before inoculation served as the source of inoculum. All leaves of each plant were wiped with inoculum on each date of inoculation previous to July 10. In the last four inoculations only the leaves on three culms of each plant were wiped and tagged. The barley was ripe by August 20. During January, field produced seed was planted in the greenhouse to determine the percent of plants that exhibited stripe-mosaic symptoms. Ten seeds from each harvested plant were sown.

EXPERIMENTAL RESULTS

The first three dates of inoculation did not result in 100 percent infection as manifested by symptom expression as read July 10, (Table 1). Subsequent observations indicated that all other dates of inoculation, except August 10, resulted in symptom development on all plants.

The depressing effect on yield was progressively greater in both varieties up to the June 20 inoculation when plant yields were the lowest. Marked yield reductions were noted in both varieties up to the inoculation at flowering time (heading July 10).

The percentage of plants exhibiting stripe mosaic symptoms when grown in the greenhouse from field produced seed increased up to and including the July 1 inoculation date. One might

---

[1] Joint contribution of the U. S. Department of Agriculture and the Montana Agricultural Experiment Station, Paper No. 361, Journal Series.

[2] Associate Agronomist, Montana Agricultural Experiment Station and also collaborator, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture; and Plant Pathologist, Montana Agricultural Experiment Station, respectively.

Table 1. Effect of date of inoculation with stripe mosaic on the incidence of symptoms, yield per plant, and stripe mosaic in the seed of Compana and Titan barley at Bozeman, Montana in 1954.

Date inoculated	Stage of development	Number of plants		Percent of plants developing symptoms		Average weight of seed per plant-grams		Greenhouse assay of percent stripe mosaic in bulked seed	
		Compana	Titan	Compana	Titan	Compana	Titan	Compana	Titan
May 20	1 leaf	10	10	10	10	17.8	9.3	4.2	1.1
June 1	3-5 leaves	11	13	55	7	10.3	7.5	25.4	0.8
June 10	tillering	17	17	94	88	10.3	10.0	34.3	1.9
June 20	tillering	17	14	100	100	6.4	6.9	46.6	2.3
July 1	in the boot	18	16	100	100	9.7	9.4	63.7	4.4
*									
July 10	heading	14	14	100	100	10.1	9.6	14.0	0.5
July 20	milk	16	16	100	100	10.9	12.0	10.1	0.0
August 1	soft dough	19	17	100	100	10.5	10.1	11.5	0.0
August 10	hard dough	18	16	?	?	11.9	11.0	14.7	0.0
None (Check)	ripe Aug. 20	25	22	0	0	12.7	9.7	1.6	0.5

* After July 1 only 3 culms per plant inoculated.

Table 2. The transfer of stripe mosaic from culms inoculated on various dates after heading to non-inoculated culms on the same plant as expressed by stripe mosaic in the seed of Compana and Titan barley at Bozeman, Montana in 1954.

Date inoculated	Stripe mosaic in seed-percent	
	3 inoculated culms	non-inoculated culms
COMPANA		
July 10	0.6	14.7
July 20	9.1	11.1
August 1	8.7	11.3
August 10	14.2	12.1
TITAN		
July 10	1.6	0.9
July 20	0.0	0.0
August 1	0.0	0.0
August 10	0.0	0.0

be inclined to attribute the lower percentage of seed-borne stripe mosaic to the lower percentage of plants expressing symptoms at the earlier dates. However, the greenhouse assays showed stripe mosaic to be present equally in plants expressing symptoms and those not expressing symptoms in the field. Seed-borne infection was at a maximum from the July 1 inoculation which was ten days later than for maximum yield reduction. Seed-borne infection was induced by inoculation up through the hard-dough stage in Compana, but not induced after heading in Titan. In general, Titan was less affected by stripe mosaic inoculation throughout the season than was Compana, whether measured by plant yield or seed-borne stripe mosaic.

Inoculation in the two-to-three-leaf stage resulted in low seed-borne infection and suggests that rogueing of diseased head-rows at that time could be practical.

Inoculations at heading and thereafter produced relatively low amounts of seed-borne infection and indicate that field inspection for stripe mosaic at about heading time would give a reasonable estimate of the amount of stripe mosaic present and would perhaps be a better index of the amount of stripe mosaic to expect in the seed than a later or earlier reading.

It should be noted that inoculations after July 1 were made only on three culms per plant (Table 2). The effect on the spikes from inoculated culms of Compana was of slightly increased percentages of seed-borne stripe mosaic up to the hard-dough stage (August 10 inoculation). Transfer of the disease to non-inoculated culms occurred up to the last inoculation, ten days before maturity. Seed-borne infection was low from the spikes from inoculated culms of Titan.

Literature Cited

1. Eslick, R. F. 1953. Yield reductions in Glacier barley associated with a virus infection. Plant Dis. Reptr. 37: 290-291.
2. Gold, A. H., C. A. Suneson, R. H. Houston, and J. W. Oswald. 1954. Electron microscopy and seed and pollen transmission of rod shaped particles associated with the false stripe virus disease of barley. Phytopathology 44: 115-117.
3. McKinney, H. H. 1951. A seed-borne virus causing false stripe symptoms in barley. Plant Dis. Reptr. 35: 48.
4. _____. 1954. Culture methods for detecting seed-borne virus in Glacier barley seedlings. Plant Dis. Reptr. 38: 152-162.

MONTANA AGRICULTURAL EXPERIMENT STATION AND FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, U. S. DEPARTMENT OF AGRICULTURE

NORMAL-APPEARING KWANZAN AND SHIRO-FUGEN ORIENTAL FLOWERING CHERRIES FOUND TO CARRY A VIRUS OF LITTLE CHERRY TYPE

E. L. Reeves, Philip W. Cheney[1] and J. A. Milbrath[2]

Kwanzan and Shiro-fugen oriental flowering cherries (Prunus serrulata) have been used extensively as test plants to indicate the presence of ring spot viruses in stone fruits[3]. Clones of the varieties originally used in this work have subsequently been widely employed by a number of other investigators. These clones were assumed to be free from latent type viruses since they grew normally and, when placed on indicator plants commonly used for stone fruit viruses, induced no foliage symptoms or abnormal growth. However, recent work conducted in Washington and Oregon has shown that when these particular clones of Kwanzan and Shiro-fugen were budded into or grown on fruiting sweet cherry trees, a serious small fruit condition developed. The evidence obtained shows that the Kwanzan and Shiro-fugen employed carried a little cherry-type virus that caused fruit symptoms to develop on Lambert and Bing sweet cherries.

Work in Washington: Observations were made in 1953, '54 and '55 on Lambert and in 1955 on Bing cherry trees which had received buds from Kwanzan or Shiro-fugen varieties of flowering cherries. The Kwanzan or Shiro-fugen trees from which the buds came were stocks maintained for use as test varieties for other viruses.

Lambert and Bing sweet cherry trees were top-worked to Kwanzan or Shiro-fugen flowering cherry at different times and for various reasons during the usual course of other experimental work but not with the intent of transmitting a virus entity. Sweet cherry trees involved in the test were 3 Lamberts that received Kwanzan buds in 1949, 11 Bings that received Shiro-fugen buds in 1949 while growing in the nursery, and 9 two year old Bings that were top-worked to Shiro-fugen in 1953. The symptoms became apparent in 1953 when the Lambert trees first produced fruits and on the first fruits produced on the Bing trees in 1955.

Symptoms were confined to fruits; the growth and foliage of all trees involved were apparently normal. At normal harvest time Lambert fruits on affected trees were not only small and lacked color but were more pointed and angular than normal fruits and many were three sided tapering toward the distal end. Affected Bing fruits also tapered toward the distal end but were less angular. Fruit measurements were taken from affected and adjacent check Bing trees. The fruits from unaffected Bing check trees averaged "10-row" size indicating a diameter of 67/64 inch. Fruits from the Bing trees with Shiro-fugen buds had an average diameter of 50/64 inch with only a few up to 52/64 inch. The 3 Lambert trees and 8 of the affected Bing trees produced a good crop of fruit in 1955 while the remaining Bing trees had only scattered fruits. Regardless of the numbers on affected trees, fruits were all small as compared with those on unaffected check trees propagated from the same budwood sources and on similar rootstocks.

The histories of the Bing and Lambert sweet cherries and the Kwanzan and Shiro-fugen flowering cherries are known for several years. The original trees or their progeny have been employed in various pathological and horticultural studies as normal trees for at least 10 years. The Lambert variety has been used locally at Wenatchee, Washington, but propagations of the other varieties have been employed by other research workers in most of the western States. By all previously recognized biological tests the Bing, Kwanzan, and Shiro-fugen gave negative reactions when tested for latent-type-virus diseases. The Lambert selection gave a negative test for a latent ring spot-like virus when indexed on Kwanzan and a positive test when indexed on Shiro-fugen.

Eleven of the 20 affected Bing trees that received Shiro-fugen buds were grown on mazzard rootstock and 9 on Mahaleb rootstock. The 3 Lambert trees were propagated by top-grafting the variety in 1948 onto arms of Mahaleb seedlings previously planted in the field in 1947. Buds of Kwanzan were placed in only 2 Lambert branches of each tree in 1949 while the other Lambert branches on the same tree received no Kwanzan buds. The rootstocks employed and the methods of handling them apparently did not influence symptom expression. Also, branches on the Lambert trees that did not receive Kwanzan buds showed just as good fruit symptoms as those that

---

[1] Respectively, Pathologist and Biological Aid, Horticultural Crops Research Branch, ARS, USDA, Wenatchee, Washington.

[2] Plant Pathologist, Oregon Agricultural Experiment Station, Department of Botany and Plant Pathology, Oregon State College, Corvallis, Oregon.

[3] Milbrath, J. A. 1954. Selecting stone fruit trees free from virus diseases. Oregon Agr. Expt. Sta. Bul. 522, 27 pp. illus.

did receive buds, indicating that the virus passed through Mahaleb.

Two of the Lambert trees have had all Kwanzan growth removed from them for 1 year and 5 of the 20 Bing trees have had no Shiro-fugen branches growing on them since they were planted in the field in the spring of 1951. The presence or absence of growing branches of Kwanzan or Shiro-fugen on the Lambert or the Bing trees has apparently not influenced the expression of small fruit symptoms.

Work In Oregon: Subsequent to the observations of this little cherry-type virus made at Wenatchee, Washington, the original source tree of the Kwanzan from which the Washington stock had been obtained and 3 other Kwanzan source trees in the Oregon plots were each placed on 3 Lambert trees of fruiting age. Ten buds were placed on each tree August 11, 1954. The following July, all 12 Lambert trees showed some abnormally small fruit giving evidence of the transmission of a virus. When the fruit on the check trees were a dark reddish black color, occasional fruit on the inoculated branches were still small, red and somewhat angular caused by two depressed areas near the apical end of the fruit on the opposite side from the suture. Other affected cherries were larger and darker in color but showed these two depressed areas. As the fruit ripened, these depressed areas were often lighter red in color, and the skin was loose and wrinkled. These fruits have the general appearance of having 2 bilateral depressions as if the side opposite the suture near the apical end of the cherry had been pressed with the thumb and forefinger. The fruit near the boundaries of the infection were nearly normal in size but were slightly flattened in the area near the apical end of the fruit opposite the suture.

The virus appeared to spread quite rapidly through the tree. In addition to affecting fruits on the inoculated branches it had already spread to some of the adjacent branches approximately 11 months after budding.

Discussion: These results are presented as a preliminary report for the following purposes: (1) to indicate to workers who have been using the flowering cherries as virus free test plants that they may be working with material already containing a virus, (2) to indicate that at least some stocks of apparently healthy flowering cherries are carrying a virus potentially dangerous to cherries, and (3) to stimulate a search for virus free sources of these valuable test plants.

It is somewhat alarming to find that apparently healthy stocks of Kwanzan and Shiro-fugen varieties of flowering cherries are carrying a virus which produces little cherry-type symptoms suggestive of those of the little cherry disease occurring only in the Kootenay area of British Columbia. In the Kootenay area little cherry has spread very rapidly and in a period of 20 years has become nearly universal, affecting all commercial varieties of sweet cherries by seriously reducing both size and quality of the fruit.

It should be pointed out that small fruit is somewhat nondescript and not sufficient for identification. Further comparisons can be made as follows: (1) While fruit symptoms obtained on sweet cherry in Washington appear to be identical with those of little cherry, affected fruits in Oregon appear to have bilateral depressions as if pinched between the thumb and finger on the side opposite the suture. (2) In Washington this virus appears to affect sweet cherry equally on either Mahaleb or mazzard rootstock and like little cherry virus passes through Mahaleb from one arm to another in double worked trees. (3) In Washington there is no evidence of natural spread in experimental plots even though infected flowering cherry trees have been maintained for several years adjacent to uninfected sweet cherry trees. While these comparisons with little cherry of the Kootenay, B. C. district are offered, more work and more data are needed before the identity of the virus can be determined.

HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE, WENATCHEE, WASHINGTON, AND DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, OREGON AGRICULTURAL EXPERIMENT STATION, CORVALLIS, OREGON

IMPORTED MAHALEB SEEDS AS CARRIERS OF NECROTIC RING SPOT VIRUS[1]

R. M. Gilmer

Cation (3) reported transmission of viruses of the sour cherry yellows complex through seeds obtained from infected mahaleb trees. Although his data did not permit an exact estimate of the number of seeds actually carrying viruses of this complex, he estimated that at least 10 percent of the seedlings produced were infected with necrotic ring spot virus and that an additional 8.7 percent were infected with cherry yellows virus on the basis of indexing on Lovell peach seedlings.

Boyle (2), using cucumber as an indexing plant, demonstrated that the percentage of virus transmission through seeds of infected St. Medard cherry might range as high as 40 percent. The identity of the virus or viruses involved was uncertain, but the cucumber technique employed would probably have indexed primarily for necrotic ring spot virus (1).

During the course of routine seed treatment tests undertaken at Geneva, New York, a lot of mahaleb seeds labeled "French Imported" was obtained from a local nursery grower. These seeds were planted in the field in October, 1954. Emergence of seedlings in May 1955 was good, averaging about 42 percent of the seeds planted. The seedlings were vigorous and normal in appearance.

Table 1. Transmission of necrotic ring spot virus from mahaleb seedlings.

Source of seedlings	Number tested	Number indexing positive in cucumber	
		June	July
"French Imported"	200	32	11
Cation[a]	100	0	--
NRS peach[b]	10[c]	10	7
Healthy peach	10[c]	0	0

[a] Seedlings of this lot were grown from seeds of virus-free mahaleb supplied by D. Cation of Michigan State College.

[b] A tree inoculated in 1954 with a strain of necrotic ring spot virus.

[c] The same tree was tested 10 times during the course of the experiment.

Two hundred seedlings of this lot were indexed by the cucumber method developed by Boyle (1, 2). One or two of the not fully expanded terminal leaves were taken from each seedling, ground in individual steam-sterilized mortars with a small amount (approximately 2 ml.) of distilled water, and the resultant leaf extract was rubbed on the cotyledons of four Chicago Pickling cucumber plants when the first true leaf was about three-fourths expanded. The initial trials were made in early June and were repeated in mid-July.

Of the 200 plants tested in June, 32 transmitted a virus to one or more plants in the cucumber test lots. Repetition of trials with the same plants in mid-July gave lower percentages of transmission (Table 1). Symptoms incited in the cucumber plants were indistinguishable from those incited by an extract from peach infected with necrotic ring spot virus.

These data demonstrate that necrotic ring spot virus, or a virus capable of inciting symptoms in cucumber plants indistinguishable from those incited by necrotic ring spot virus, occurs in Europe and may be imported into the United States in mahaleb seeds.

Literature Cited

1. Boyle, J. S. 1954. Cucumber as a host plant in stone fruit virus

[1] Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 1016.

research. Phytopath. 44: 303-312.
2. Boyle, J. S. Unpublished data.
3. Cation, D. 1949. Transmission of cherry yellows virus complex through seeds. Phytopath. 39: 37-40.

DEPARTMENT OF PLANT PATHOLOGY, NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA

STREPTOMYCIN AS A CONTROL FOR DOWNY MILDEW OF CUCURBITS

Donald M. Coe

Streptomycin sulfate has been shown[1] to control blue mold of tobacco (Peronospora tabacina Adam) and has come into use for this purpose in some areas.

This note reports preliminary results on the control by a streptomycin formulation of another of the phycomycetous fungi: Pseudoperonospora cubensis (Berk. & Curt.) Rostow., the cause of downy mildew of cucurbits.

Randomized plots were planted on sandy land at Ft. Pierce, Florida on April 14, 1955 to Marketer cucumber. Each single row plot was 25 feet long and replicated four times. The weather during this period and subsequently was abnormally dry and a poor stand necessitated replanting the "skips" 2 weeks later. All plots were given a weekly spray of zineb at 2 pounds per 100 from May 1 to May 31 when these applications were terminated. Downy mildew was not being adequately controlled by this schedule.

Table 1. Harvest and disease control data on control of cucumber downy mildew by streptomycin, Ft. Pierce, Florida, June, 1955.

Treatment	Concentration	Total yield in pounds	Disease control index[a]
1. Agrimycin	100 ppm	111.0	3.63
2. "	200 ppm	180.2	4.75
3. Tribasic copper sulfate	4#/100	203.6	6.00
4. Agrimycin plus tribasic copper	50 ppm: 2#/100	195.3	5.13
5. " "	100 ppm: 2#/100	176.3	6.38
6. " "	100 ppm: 4#/100	186.0	6.88
7. Check -- no treatment	---	126.2	2.25
L.S.D. 5%		NS	1.241
L.S.D. 1%		NS	1.70

[a] Disease control scored on a 1-10 basis.

Beginning on May 23, Agrimycin[2] and Agrimycin plus tribasic copper sprays were superimposed on the zineb treatment until May 31 and continued alone thereafter on a 4- or 5-day schedule until June 20 for a total of seven applications. The materials and formulations are shown in Table 1. Visual evidence of control became noticeable June 6.

Harvest of mature cucumber fruits was begun on June 8 and continued three times weekly for a total of nine pickings until June 27. The total weight of fruits harvested per treatment is recorded in Table 1. Although records were kept on the fruit size and grade, these data yielded no additional information.

The plots were rated for disease control on June 20. The average indices are recorded in Table 1. The figures show a significant control of downy mildew by the use of Agrimycin at 200 ppm at both the 5 percent and 1 percent levels. The tribasic copper alone at 4 pounds per 100 gave further significant increase in control. By combining Agrimycin and copper at various levels some interesting comparisons are evident. It appears that an additive effect, as previously recorded by Cox[3], is accomplished, which is significant in comparing treatment 1

[1] Grosso, John J. 1954. Control of tobacco blue mold by antibictics. Plant Dis. Reptr. 38: 333.

[2] Agrimycin 100, a trademarked formulation prepared and furnished by Chas. Pfizer and Co., containing 15% streptomycin and 1.5% oxytetracycline (Terramycin).

[3] Cox, R. S. 1955. Compatibility between a streptomycin-terramycin formulation and copper in the control of bacterial blight of celery. Plant Dis. Reptr. 39: 484-486.

with 5 and 6. Further trials should incorporate opportunities for more direct comparisons.

The harvest data failed to show statistical significance although the yields strongly tended to parallel the disease control index ratings. The calculated F value for treatments was 2.53 whereas 2.66 is required for significance. The variability between plots in the harvest data was great. This can be readily attributed to several factors. Most important were localized aphid colonies which reduced the yield to practically nothing in areas 3 to 5 feet long. The necessity for replanting parts of the plots, as noted, plus the fact that the crop was grown in a period at least 4 to 6 weeks beyond that considered optimum for this area, lends greater credence to the harvest data as supporting the disease control indices than the statistical analysis would indicate.

INDIAN RIVER FIELD LABORATORY, EVERGLADES EXPERIMENT STATION, UNIVERSITY OF FLORIDA, FT. PIERCE, FLORIDA

EFFECT OF STREPTOMYCIN FORMULATIONS ON ANGULAR LEAF SPOT IN CUCUMBER

S. P. Doolittle and F. S. Beecher[1]

Streptomycin has been extremely effective in controlling some bacterial diseases of fruits and vegetables and tests were begun in 1954 to determine its value for control of angular leaf spot of cucumbers, caused by Pseudomonas lachrymans. Cox et al. (3) in trials with bacterial spot of pepper, caused by Xanthomonas vesicatoria, found that three sprayings with streptomycin at 500 ppm suppressed secondary spread of the causal organism. It was hoped that similar results might be obtained with P. lachrymans, since this organism is seed-borne and primary infection usually occurs on comparatively few plants. Ark's (1) report that soaking cucumber seed contaminated with the angular leaf spot organism in a streptomycin solution gave effective control indicated that streptomycin might be effective in protecting the plants against this organism. Tests of the effects of various antibiotics on P. lachrymans in vitro showed that growth was inhibited by streptomycin as well as by Terramycin, Aureomycin, and Chloromycetin.

GREENHOUSE TESTS

In a preliminary greenhouse test, a lanolin paste containing 1% streptomycin was applied to the stems and petioles of 3 leaves each of 6 young cucumber plants. The same material was applied to only the stems of 6 other plants[2]. The 3 cucumber leaves with treated petioles and 3 comparable ones on each plant treated on only the stem were inoculated by rubbing with a cheesecloth pad dipped in a suspension of P. lachrymans to which carborundum powder had been added. After 14 days, 11 of the leaves with treated petioles showed no lesions and the other 7 averaged 3.6 lesions per leaf. All leaves of plants treated on the stem alone were infected and averaged 16.4 lesions per leaf. Leaves of the untreated checks averaged 26.1 lesions. These results indicated that streptomycin can be taken up by the cucumber leaf. In a parallel test treatment with Terramycin did not reduce infection below that on the untreated plants.

In other greenhouse tests both sides of cucumber leaves were sprayed with streptomycin solutions to which Tween 20 had been added as a wetting agent. The plants were inoculated 24 hours after treatment. In a trial with sets of 5 plants, each with 3 leaves inoculated, 1000 ppm and 500 ppm of pure streptomycin prevented infection, and 250 ppm reduced infection to 16.3 lesions per leaf as compared with approximately 72 lesions per leaf on the unsprayed plants. In a later test, an Agri-mycin 100[3] spray was applied to sets of 10 plants at rates giving 400 and 40, 300 and 30, and 200 and 20 ppm of streptomycin and Terramycin, respectively. At 400-40 ppm the inoculated leaves averaged 1.8 lesions per leaf; at 300-30 ppm 4.5, and at 200-20 ppm 6.3. The unsprayed plants averaged 16.3 lesions per leaf. These preliminary tests indicated that concentrations below 200-20 ppm would not give adequate control.

1954 FIELD TESTS

On the basis of the results in the greenhouse, field tests were conducted in 1954 with artificially inoculated plants. The antibiotic used was Agri-mycin 100 applied at rates giving 400 ppm of streptomycin and 40 ppm of Terramycin, a concentration that seemed sufficient for a high degree of control, and 200 ppm of streptomycin and 20 of Terramycin, which was considered to be the lowest level that could be expected to give control. Tri-basic copper sulfate[4] was used for comparison since it had controlled angular leaf spot in earlier trials (2). It was applied at the rate of 3 pounds to 100 gallons with the addition of Tween 20 as a wetting agent.

---

[1] Pathologists, Vegetable Crops Section, Horticultural Crops Research Branch, Agricultural Research Service, Beltsville, Maryland.

[2] The writers are indebted to J. W. Mitchell, Horticultural Crops Research Branch, Agricultural Research Service, for assistance with this phase of the greenhouse work.

[3] Agri-mycin 100, a trademarked formulation containing 15% streptomycin, 1.5% Terramycin, a wetting agent, and an inert carrier. Furnished through the courtesy of the Chas. Pfizer Co., Inc.

[4] A trademarked preparation furnished through the courtesy of the Tennessee Corp., Copperhill, Tennessee.

Table 1. Prevalence of angular leaf spot lesions on cucumber plants sprayed with a streptomycin-Terramycin mixture and Tri-basic copper sulfate before inoculation with Pseudomonas lachrymans.

Treatment	Mean lesions per plant[a] sprayed			Mean
	14 days before inoculation	14 and 8 days before inoculation	14, 8, and 2 days before inoculation	
	Number	Number	Number	
Streptomycin (200 ppm) and Terramycin (20 ppm)	100.07	104.51	89.08	97.89
Streptomycin (400 ppm) and Terramycin (40 ppm)	86.70	92.12	50.67	76.50
Tri-basic copper sulfate (3 lb.-100 gal.)	96.05	105.18	77.51	92.91
None (check)	119.23	117.31	127.18	121.24
Mean:				
Including checks	100.51	104.78	86.11	97.13
Excluding checks	94.27	100.61	72.42	89.10

L.S.D. (.05 level):	
Between treatments and checks	17.35
Treatments x sprayings, including checks	15.23
Between treatments, excluding checks	18.26
Between sprayings, excluding checks	24.53
Treatments x sprayings, excluding checks	13.03

[a] Mean of lesions on third and fifth leaves.

Inoculated but untreated check rows were included. Application was made with a wheelbarrow-type power sprayer giving 200 pounds' nozzle pressure. The plants were inoculated with a broth culture of P. lachrymans diluted with tap water and applied with the power sprayer mentioned. In the early tests a 1-30 dilution of the culture was used since a similar low dilution had been necessary for adequate infection in greenhouse experiments. In the field, however, it produced a much more severe infection than had been hitherto observed and in later tests the dilution was increased. Each plot consisted of 12 hills of 2 plants each spaced 2 feet apart in rows 6 feet apart. There were 4 replicates, making a total of 96 plants per treatment. In these and all later experiments, the Marketer variety of cucumber was used. The protection afforded by sprays applied before inoculation and the possibility of stopping secondary spread of the bacteria by sprayings begun soon after inoculation were tested.

June-July Tests

Protection Test: Although experimental work with other hosts indicated that an application of the antibiotic shortly before inoculation might give maximum control, it was decided to test the effect of other applications some time prior to inoculation. Therefore 1 set of plots was sprayed 14 days before inoculation, another set 14 and 8 days before, and a third 14, 8, and 2 days before. The plots were arranged in 4 randomized blocks each including rows receiving 1, 2, or 3 sprayings. An unsprayed plot was included in each section of the block. Sprayings were made on June 18, 24, and 30, beginning when the plants had five leaves. Inoculation was done on July 2, when there were eight or nine leaves per plant.

Data in the protection test were taken on the basis of individual leaf infection. Infections were grouped in the following classes: 1-10, 11-30, 31-60, 61-100, and 101-150 lesions per leaf. After a number of preliminary counts had been made, it was found that the number of lesions per leaf could be estimated fairly accurately by inspection. For analyses the estimates were listed as the approximate mid-points of the classes (5, 20, 45, 80, and 125 lesions). On July 12 and 13 data were taken on the third and fifth leaves of each plant since test sampling indicated that this was adequate. From the total ratings of the two leaves for each plot the num-

Table 2. Secondary angular leaf spot infection on cucumber plants sprayed with a streptomycin-Terramycin mixture and with Tri-basic copper sulfate beginning 3 days after inoculation with Pseudomonas lachrymans.

Treatment	Mean infected leaves per plant sprayed: 3 days after inoculation	3 and 8 days after inoculation	3, 8, and 13 days after inoculation	Mean
	Number	Number	Number	
Streptomycin (200 ppm) and Terramycin (20 ppm)	6.58	4.87	3.60	5.02
Streptomycin (400 ppm) and Terramycin (40 ppm)	5.51	4.19	1.05	3.58
Tri-basic copper sulfate (3 lb.-100 gal.)	6.05	4.79	3.57	4.80
None (check)	8.42	9.66	9.20	9.10
Mean:				
Including checks	6.64	5.88	4.36	5.63
Excluding checks	6.05	4.61	2.73	4.47

L.S.D. (.05 level):	
Between treatments and checks	1.65
Treatments x sprayings, including checks	1.01
Between treatments, excluding checks	.55
Between sprayings, excluding checks	.82
Treatments x sprayings, excluding checks	.75

ber of lesions per plant was computed.

All sprays applied 3 times reduced infection significantly below that in the unsprayed plots (Table 1), but even 3 sprayings with the streptomycin-Terramycin mixture at 400-40 ppm did not give satisfactory control, apparently because of the severity of infection. There was no significant difference in the degree of control by the antibiotic mixture at 200-20 ppm and that by the copper spray. There was no significant difference between 1 and 2 sprayings with any one material, but in the plots sprayed 3 times the number of lesions was significantly reduced.

Eradication Tests: In the eradication tests the same treatments were used and the plants were inoculated on July 2 as in the protection test. Likewise there were 3 sets of plots in randomized blocks replicated 4 times. In one test all the plots were sprayed 3 days after inoculation, when very small, water-soaked lesions had appeared on the infected leaves. Two sets were sprayed again 5 days later and 1 set received a third spraying 10 days after the first. In a second test, the same procedure was followed, but spraying did not begin until 5 days after inoculation, when well-developed angular lesions had appeared on the leaves. The objective was to determine whether the later dissemination of the causal organism would be affected by the stage of lesion development at which the antibiotic was first applied.

At the close of the tests the plants were large and as many as 10 leaves showed secondary infection, but the number of lesions per leaf was small, not more than 10 per leaf. The total number of infected leaves in each plot was recorded 10 days after the last spraying and the average number per plant was computed. The results of the two tests were similar (Tables 2 and 3). The time of beginning the sprayings had no marked effect on the amount of secondary infection. All treatments reduced infection significantly below that on the unsprayed plants. The number of infected leaves decreased significantly with each increase in the number of sprayings. As in the protection test, the streptomycin-Terramycin mixture at 200-20 ppm gave a degree of control equal to that with the copper spray. When 3 sprayings were made, streptomycin-Terramycin at 400-40 ppm was significantly superior to the other treatments in both tests and with 3 sprayings the average number of infected leaves per plant was reduced to 1 or less. The primary infection of the plants was much more severe than would be likely to occur

Table 3. Secondary angular leaf spot infection on cucumber plants sprayed with a streptomycin-Terramycin mixture and with Tri-basic copper sulfate beginning 5 days after inoculation with Pseudomonas lachrymans.

Treatment	Mean infected leaves per plant sprayed			Mean
	5 days after inoculation	5 and 10 days after inoculation	5, 10, and 15 days after inoculation	
	Number	Number	Number	
Streptomycin (200 ppm) and Terramycin (20 ppm)	7.59	4.46	3.38	5.14
Streptomycin (400 ppm) and Terramycin (40 ppm)	6.01	3.35	0.71	3.36
Tri-basic copper sulfate (3 lb.-100 gal.)	6.31	4.88	3.02	4.73
None (check)	9.54	9.64	8.79	9.32
Mean:				
Including checks	7.36	5.58	3.97	5.64
Excluding checks	6.63	4.23	2.37	4.41

L.S.D. (.05 level):	
Between treatments and checks	.92
Treatments x sprayings, including checks	1.06
Between treatments, excluding checks	.63
Between sprayings, excluding checks	.98
Treatments x sprayings, excluding checks	.57

naturally in the field. Therefore, it appeared possible that less than 3 treatments of the antibiotic mixture at 400-40 ppm might eradicate the organism when the plants have a light primary infection.

August Tests

A second set of tests was made in August 1954 to determine the protective and eradicative effects of the antibiotic treatments on plants less severely infected than in the June-July tests. The plants were inoculated by the same method, but a finer nozzle was used. The inoculum consisted of a 24-hour culture of Pseudomonas lachrymans diluted 1-42 in tap water. The plots again consisted of 12 hills of 2 plants, each spaced 2 feet apart in the row.

Protection Test: In this test the plants were sprayed on August 11 with the same materials as used in the June-July tests. On August 12, when there were 5 well-developed leaves per plant, the plants were inoculated with P. lachrymans. Infection was much less severe than in the earlier tests, but equivalent to a very severe early infection in the field. On August 20 the approximate number of lesions on all leaves was recorded; but, because of the reduced number of lesions per leaf, a different system of rating was used than in the previous experiment. The rating classes were 1-10, 11-20, and 21-40 lesions per leaf, and the average infection per plant was calculated from approximate mid-points (5, 15, and 30) of these classes.

The means of the lesions per plant were 9.88 for the streptomycin-Terramycin mixture at 200-20 ppm, 3.8 for streptomycin-Terramycin at 400-40 ppm, 12.50 for Tri-basic copper sulfate (3-100), and 39.93 for the unsprayed plants (Check). The L.S.D. (.05 level) between treatments, excluding the check, was 1.89 and that between treatments and the check 4.66. The streptomycin-Terramycin mixture at 400-40 ppm again gave significantly better control than the other materials.

Eradication Test: In this test randomized blocks of plants, replicated 4 times, were sprayed 1, 2 and 3 days, respectively, after inoculation. The same materials as in the pro-

Table 4. Prevalence of angular leaf spot lesions on cucumber plants sprayed with formulations of streptomycin and Tri-basic copper sulfate after inoculation with Pseudomonas lachrymans.

Treatment	Mean lesions per plant[a] sprayed			Mean
	1 day after inoculation	2 days after inoculation	3 days after inoculation	
	Number	Number	Number	
Streptomycin (200 ppm) and Terramycin (20 ppm)	7.09	8.17	7.96	7.74
Streptomycin (400 ppm) and Terramycin (40 ppm)	3.32	2.08	2.79	2.73
Tri-basic copper sulfate (3 lb.-100 gal.)	16.84	13.22	21.26	17.11
None (check)	48.06	41.08	39.78	42.97
Mean:				
Including checks	18.83	16.14	17.95	17.64
Excluding checks	9.09	7.82	10.68	9.20

L.S.D. (.05 level):

Between treatments and checks	5.76
Treatments x sprayings, including checks	6.82
Between treatments, excluding checks	.78
Treatments x sprayings, excluding checks	1.45

[a] Based on all infected leaves.

tection test were used to obtain further information as to what extent multiplication of P. lachrymans would be inhibited by applying an antibiotic shortly after its entrance into cucumber leaves. The plants were inoculated at the same time as those in the protection test, and the amount of infection was recorded on August 23.

Plants sprayed with the streptomycin-Terramycin mixture at 400-40 ppm had significantly fewer lesions than those treated otherwise (Table 4). Tri-basic copper sulfate reduced infection below that on the unsprayed plants but was significantly less effective than the antibiotic mixtures. However, the number of lesions, as compared with that on the unsprayed plants, indicates that the copper compound, as well as the antibiotic, has eradicant value when applied soon after inoculation. There was no significant difference in infection on plants sprayed 1, 2, or 3 days after inoculation. The amount of infection with 1, 2, or 3 sprayings with the antibiotic after inoculation was about equal to that on plants sprayed with the same concentration 1 day before inoculation.

1955 FIELD TESTS

After the second group of tests in 1954, it was decided to make a further attempt, in 1955, to determine whether secondary spread of angular leaf spot could be prevented by spraying with formulations of streptomycin. Provision also was made for obtaining further data on protection against infection. In these tests the plants were sprayed with Agri-mycin 100, Agri-strep[5], and Tri-basic copper sulfate. The antibiotic formulations were used at rates giving 400, 300, and 200 ppm of streptomycin, and Tri-basic copper sulfate at 3 pounds to 100 gallons.

The tests included plots sprayed on June 22, one day before inoculation, a second set sprayed 5 days after inoculation, when there was definite spotting of the leaves, and a third set sprayed 5 and 10 days after inoculation. The plots were of the same size as in 1954 and were randomized in blocks replicated 4 times. There were unsprayed (check) plants for each set of treatments. Inoculation was made as in previous tests, but the culture was diluted 1-54 with tap water. Despite the higher dilution of inoculum, infection was much heavier than ob-

[5] A trademarked formulation containing 37% streptomycin, a wetting agent, and an inert carrier. Furnished through courtesy of the Merck Co., Inc., Rahway, New Jersey.

tained in the test of August 1954. Secondary spread was negligible because of unfavorable weather conditions and data were obtained only from plants sprayed 1 day before inoculation.

The number of lesions on all infected leaves was recorded on June 29. Since infection was severe, the rating used was that of the June-July protection test of 1954; the mid-points of the various infection classes were 5, 20, 45, 80, and 125 lesions. Infection on most of the leaves fell in the first three classes. The means of the lesions per plant were as follows:

Agri-mycin 100 --	
Streptomycin (200 ppm) and Terramycin (20 ppm)	30.56
Streptomycin (300 ppm) and Terramycin (30 ppm)	22.08
Streptomycin (400 ppm) and Terramycin (40 ppm)	9.95
Agri-strep --	
Streptomycin (200 ppm)	28.64
Streptomycin (300 ppm)	22.50
Streptomycin (400 ppm)	10.93
Tribasic copper sulfate (3-100)	40.95
Check	91.20

The L.S.D. (.05 level) between treatments and check was 24.16 and that between treatments, exluding the check, was 8.48.

Both formulations of streptomycin reduced the number of lesions significantly below that on the unsprayed plants. Plants treated with Agri-mycin 100 and Agri-strep at rates giving equal amounts of streptomycin showed no significant differences in the degree of control. Streptomycin at all concentrations was more effective than the copper compound.

DISCUSSION

In these tests the control of angular leaf spot by streptomycin at 400 ppm was much superior to that by the same antibiotic at 300 ppm and 200 ppm or by Tri-basic copper sulfate. A formulation (Agri-strep) containing streptomycin alone and one (Agri-mycin 100) containing a mixture of streptomycin and Terramycin were equally effective at the same concentrations. When used as a protectant, streptomycin at 200 ppm was superior to the copper compound in 2 of 3 tests and the same was true in a test with 300 ppm of this antibiotic. It is doubtful whether the degree of control obtained with these concentrations of streptomycin warrants their use in commercial plantings. With a very heavy infection of the angular leaf spot organism, 3 sprayings with streptomycin at 400 ppm reduced secondary spread to a trace. It is possible that, when primary infection is light, 2 sprayings at 400 ppm might be sufficient to prevent the spread of Pseudomonas lachrymans. Further tests are needed to check this possibility because secondary spread was negligible in the 1955 test.

Literature Cited

1. Ark, P. A. 1949. Uses of streptomycin in agriculture. In "Streptomycin," edited by S. A. Waksman, pp. 607-612. Baltimore, Williams and Wilkins.
2. Beecher, F. S., and S. P. Doolittle. 1950. Control of angular leaf spot of cucumber with a copper fungicide. Plant Dis. Reptr. 34: 383.
3. Cox, R. S., W. A. Comegys, and J. W. Heuberger. 1953. Preliminary tests with antibiotics for the control of bacterial leaf spot of pepper. Trans. Peninsula Hort. Soc. (Bul. Delaware St. Bd. Agr. 43).

HORTICULTURAL CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MARYLAND

LATE BLIGHT OF POTATOES AND TOMATOES IN NORTHERN RHODESIA

E. A. Riley[1]

It is now confirmed that an outbreak of late blight (Phytophthora infestans (Mont.) DBy) has occurred at the Nkana Mine Garden on potatoes and tomatoes. As far as can be ascertained, this is the first record of the disease in Northern Rhodesia. This occurrence must be viewed with some concern in the light of Southern Rhodesian expérience over the last few years. There has been an apparent "building-up" of the disease there which, it would seem, cannot be entirely attributed to particularly favourable weather conditions. Hopkins ("Diseases of Potatoes" Bulletin No. 1561 of 1951) says that only a single outbreak over a small number of farms had been recorded up to that time. In 1952, 1953, and 1954, however, there were serious outbreaks over quite a wide area and severe damage was caused to the potato crop in Southern Rhodesia by this disease. An increase in the number of cases and in their severity may therefore not be unexpected locally in subsequent seasons. I feel that this is an opportune time, therefore, to note down a few facts concerning late blight, and in particular with reference to the local occurrence, with a view to meeting any further outbreaks.

The disease was first noted by Mr. Hadfield of the Nkana Mine Garden on tomatoes (varieties Southland and Marvel) as causing damage to the foliage. The plants in question were well-grown at the time and had several trusses of fruit. Adjoining potatoes were not noticed to have signs of infection at this time. The latter were quite young (about 6 weeks). The disease progressed rapidly on the tomatoes and later the potatoes were also severely affected. The only possible source of infection would appear to be the potatoes used for seed as the fungus is not reported to be carried in any other way. It is suggested that the initial infections in potatoes were overlooked and that the disease was then carried across to the tomatoes. Possibly the tomatoes were more susceptible than the potatoes at this time, or, what is more likely, the microclimate in the well-grown tomatoes was more favourable for disease development than in the young potato crop. Complete destruction of 4 acres of tomatoes and 2 acres of potato haulms ensued.

Seed was supplied by the South African Potato Board and this matter has been taken up with them to try and trace the source of infection.

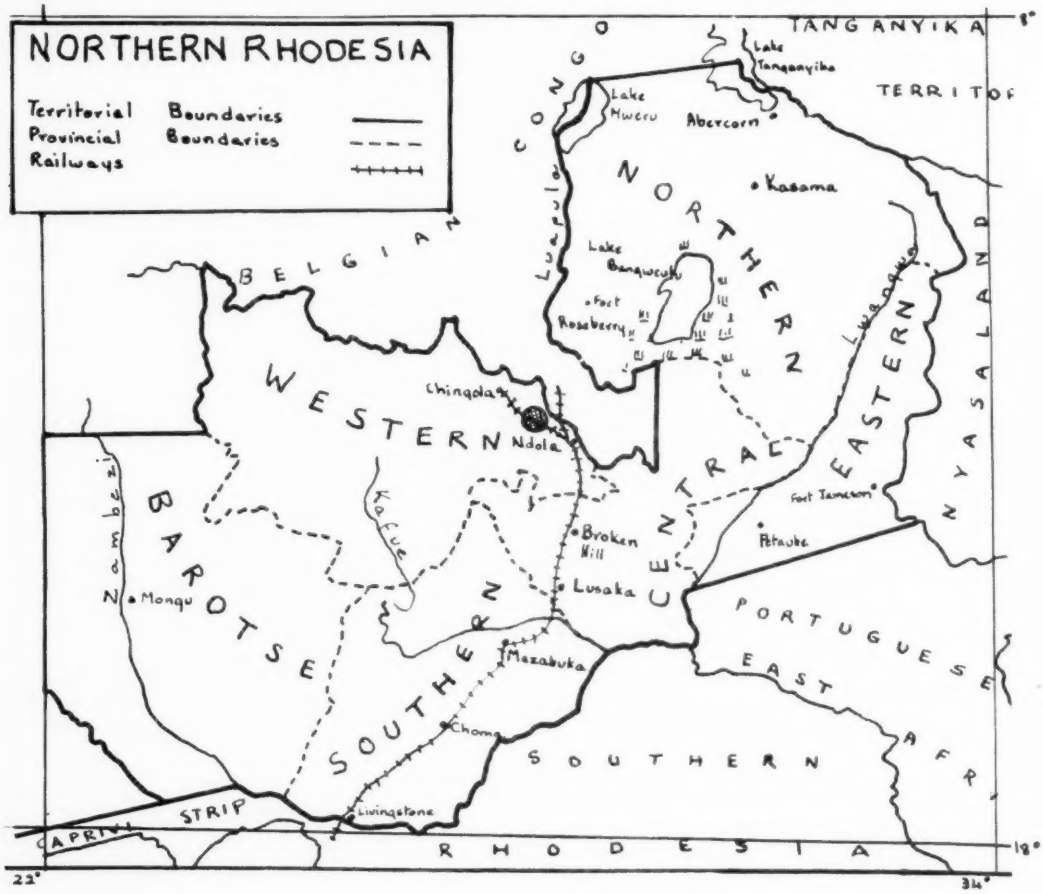
The climatic requirements for the development of late blight epiphytotics are critical. The well-known Beaumont Rule used for forecasting outbreaks in England states that "outbreaks of late blight can be expected within 15-21 days following a period of at least 48 hours in which relative humidity was maintained at 75 or more and the temperatures at not less than 50° F". Conditions required for outbreaks have been expressed in various ways in different countries, e.g., conditions in Holland are stated as "dew for at least 4 hours during the night, temperature of at least 50° F and a mean cloudiness of 0.8 or above."

In the absence of figures for Nkana, the following meteorological data were obtained at N'dola, some 36 miles distant from the outbreak. The data refer to the period: 12 to 19 days preceding the occurrence of late blight.

Date	Relative humidity			Temperature	
	Maximum	Minimum	Mean	Maximum	Minimum
April 1	88	41	64.5	54	81
April 2	94	42	68.0	58	81
April 3	94	38	66.0	54	80
April 4	88	38	63.0	55	80
April 5	100	45	72.5	52	81
April 6	100	42	71.0	55	81
April 7	100	40	70.0	56	83

The data quoted are for readings made above ground level in a screen and do not reflect precise conditions within a crop. Relative humidity could be expected to be somewhat higher under crop conditions. On April 5, 6, and 7 conditions were approaching the ideal for the de-

[1] Plant Pathologist, Mount Makula Research Station, Lusaka, Northern Rhodesia.



● - Approximate area of late blight outbreak on potatoes and tomatoes, 1955.

FIGURE 1. Late blight in Northern Rhodesia.

velopment of late blight. In addition to the relative humidity and temperature criteria, extreme cloudiness persisted over the whole week under review. The disease was first noticed on April 19.

The Meteorological authorities at N'dola have very kindly offered to collect data for the past 10 years to determine whether the conditions referred to above are a regular feature of climatic conditions in Northern Rhodesia at this time of year. This may prove of considerable assistance in forecasting outbreaks of late blight in the future.

Control of late blight elsewhere, and in particular in Britain, is by timely spraying on receipt of a warning to the effect that weather conditions have fulfilled the requirements of the Beaumont Rule. In actual practice, in the United Kingdon, such conditions can only be expected to be followed by outbreaks at certain times of the year. The same will no doubt apply locally. Spraying is usually done at 10 to 14-day intervals (maximum 3 sprayings) with 4:4:50 Bordeaux mixture, or Burgundy mixture, although in the United States organic fungicides have recently found favour.

Following the outbreak at Nkana, spraying was carried out with Blitane (Zineb), an organic fungicide. As the results were disappointing, it would seem we should be well advised to adhere to copper fungicides in the future.

With a view to checking the spread and possibility of further outbreaks of late blight, all tomato foliage and fruit and potato haulms at the Nkana Mine Garden have been destroyed by burning. The potato crop will be lifted shortly and disposed of as quickly as possible.

MOUNT MAKULA RESEARCH STATION, LUSAKA, NORTHERN RHODESIA

SWEETPOTATO SCURF CONTROL STUDIES IN NEW JERSEY, 1942-1952

Robert H. Daines

Summary

Sweetpotato scurf (Monilochaetes infuscans) is more severe and difficult to control in heavier soils than in sandy loam.

Data are presented that show seed sweetpotato dip treatments, soil (in plant bed) treatments, and sprout treatments to be of aid in the control of sweetpotato scurf.

Of the sweetpotato seed treatments used in these tests, ferbam and thiram were most effective. Although borax 1 pound to 5 gallons water showed considerable promise in the control of scurf, it occasionally produced injury as expressed in retarded sprout emergence and blackened leaf margins. Borax at a lower dilution (1-10), while not effective against scurf, did not produce the injury here noted. The degree of control provided by Semesan Bel (1-7 1/2) in sassafras loam was disappointing.

Ferbam, at the rate of 500 pounds per acre, worked into the soil in the plant bed, proved to be effective in the control of scurf.

Of the sprout treatments used, Tersan (thiram) (1 or 2-5) and Fermate (ferbam) (1 or 2-5) proved to be most satisfactory. However, Dithane Z-78 (zineb), Zerlate (ziram), Phygon (dichlone), Puratized Agricultural, and captan deserve further testing. As a sprout treatment Semesan Bel, and Dithane D-14 (nabam) plus zinc sulfate and lime, produced injury to the treated sprout roots. In all experiments Semesan Bel burned the secondary rootlets off the treated sprouts. In addition it was disappointing in the control of scurf where the plants were grown in heavy soils. Spergon (chloranil) proved to be ineffective against scurf, but combinations of chloranil and ferbam or Tersan were effective in controlling the disease.

In 1922 Poole (6, 7) stated that "fully 50 percent or more of the sweetpotatoes harvested in New Jersey have been affected with scurf." In 1942 Daines (1) reported that this disease annually exacts a heavy toll from the value of the New Jersey sweetpotato crop. At present sweetpotatoes showing scurf are difficult to find in New Jersey. This paper considers some essential information concerning this disease. Also, experiments designed to discover improved measures for scurf control are discussed.

Scurf of sweetpotatoes (Monilochaetes infuscans) is reported to occur in every sweetpotato-growing area in the United States, and it affects all commercial varieties grown in New Jersey.

Scurf may occur as small, circular, brownish or blackish spots on all underground parts of the sweetpotato plant. When there are many of these small spots, they may coalesce to form a uniform brownish patch, which, in severe cases, may involve the entire sweetpotato. On red-skinned varieties the infected areas become almost black. Severely affected sweetpotatoes may become more or less prominently cracked.

The fungus is largely superficial; however, it does penetrate deeply enough into the tissue to allow moisture to escape, which causes the root to shrivel excessively in storage. Poole (6) reports that during a storage period of approximately 2 months, severely scurfed sweetpotatoes lost 30.0 percent in weight, whereas sweetpotatoes showing no scurf lost only 7.7 percent, from shrinkage.

Losses are due primarily to the unsightly appearance and poor keeping qualities of the affected sweetpotatoes. Both salability and sale value are sharply reduced where scurf is present. In addition, Taubenhaus (9) found that the fungus reduced yields somewhat, by attacking the young rootlets.

The fungus lives through the winter on diseased sweetpotatoes and on organic matter in the soil either in the plant bed or in the field. When diseased sweetpotatoes are planted in the seedbed the fungus may spread to the sprouts. In the field the fungus grows down these sprouts and infects the developing sweetpotatoes. Observations made over a period of years in New Jersey suggest that in sandy soils a large portion of the scurf occurring in the field has its origin from diseased sprouts.

Sweetpotatoes may, under some conditions, also become infected by the scurf organism

---

[1] Paper of the Journal Series, New Jersey Agricultural Experiment Station, Rutgers University, the State University of New Jersey, Department of Plant Pathology, New Brunswick.

Table 1. Fungicides used for the treatment of seed sweetpotatoes for scurf control.

Materials used	Percentage of sweetpotatoes showing scurf					
	1943	1944	1946	1948	1949	1950
1. Untreated check	86.6	92.0	87.3	85.2	28.8	41.1
2. Semesan Bel (1-7 1/2)[a]	60.2	67.3	58.1	60.6	23.8	34.0
3. Borax 1-5 5-min. soak		50.3	46.4			
4. Borax 1-10 5-min. soak			57.7			31.6
5. Ferbam 1-5			39.4	52.9	18.7	22.7
6. Thiram 1-5			40.2			
7. Dichlone 1-5			54.0			

[a] Pounds - gallons of water.

Table 2. Seed sweetpotato dips and seed bed soil treatment for scurf control.

Treatment	1951		1952	
	Weighted average sweetpotatoes showing scurf (Percent)	Mean radians	Weighted average sweetpotatoes showing scurf (Percent)	Mean radians
1. Check	78.3	60.9	24.7	25.8
2. Semesan Bel dip 1-7 1/2	64.1	53.6	13.0	21.8
3. Borax 1-10, 5-min. soak	60.2	51.8	16.3	24.3
4. Ferbam in surface of soil (1 lb. - 100 sq. feet)	56.9	48.4	9.1	17.8**
5. Borax soak 1-10, plus Ferbam in surface of soil (1 lb. - 100 sq. feet)	53.7	47.6*		
6. Ferbam dip 2-10	58.3	46.5*	10.6	18.5**
7. Thiram dip 4-10			6.0	14.3**
8. Ferbam dip 4-10			6.8	14.7**
9. Tag dip 1-1000 (phenyl mercury)			14.3	21.4
L.S.D. Mean radians -- 5% level		13.2		4.7
L.S.D. Mean radians -- 1% level		17.9		5.7

* Statistically significant at the 5% level.
** Statistically significant at the 1% level.

Table 3. Soil treatment in plant beds and seed sweetpotato dip treatments for scurf control.

Treatment	Percent of sweetpotatoes showing scurf				
	1948	1949	1950	1951	1952
1. Check untreated	80.9	28.9	41.1	78.3	24.7
2. Ferbam 500 lbs. acre worked in soil[a]	30.2	14.0	30.8	56.9	10.6
3. Semesan Bel dip 1-7 1/2		23.8	34.0	64.1	13.0
4. Ferbam dip 1-5		18.7	22.7	48.3	9.1

[a] Ferbam raked into surface of plant bed. In 1948 and 1949 ferbam mixed in soil used to cover sweetpotatoes.

living on organic matter in the soil. Scurf is most common on sweetpotatoes growing in black soil areas (organic matter), and in fields during the first year or two following the turning under of heavy leguminous cover crops. The replacing of manure by commercial fertilizers has undoubtedly had an influence in reducing the incidence of this disease. Scurf is more of a problem in heavy than in sandy soils, and ample moisture and cool soils during the month or two preceding harvest favor its development.

Experiments on control of scurf have shown that acidulating the soil to a pH range between 4.2 to 5.4 materially reduces the incidence of the disease. Crop rotation has given variable results (6).

Since the fungus may live from one year to the next in the seed bed soil, the use of new soil or a formaldehyde seed bed drench before bedding has been recommended by Daines (1) and others (5).

The use of scurf-free seed sweetpotatoes and a dip treatment before bedding have been generally recommended as a valuable aid in control. Soaking the seed roots in a solution of bichloride of mercury (10) was used very early. Instantaneous dip treatments for seed sweetpotatoes (8) were made possible by the development of the organic mercuries. Even more important, however, these compounds (4) also made it possible to use fungicides as dip treatments for the sprouts before setting in the field. The organic mercury most widely used for this purpose was New Improved Semesan Bel. Although this treatment represents a significant advancement, it never received general approval in New Jersey because of frequent sprout injury following its use. Injury was especially destructive when conditions at planting time were not ideal. Under such circumstances the replanting of entire fields was not uncommon. With the development of the carbamates, effective fungicides that could be used with freedom from sprout injury (3) became available and their widespread commercial acceptance has been largely responsible for the all but complete disappearance of scurf from New Jersey.

EXPERIMENTS ON CONTROL

In 1942 experiments designed to explore the possibilities of developing improved methods and materials for scurf control were begun. A number of materials including thiram, ferbam, ziram, zineb, captan (SR 406), dichlone, chloranil, a phenyl mercury fungicide, borax, and several numbered compounds, together with New Improved Semesan Bel, were extensively tested for seed, sprout, or seedbed treatments. Although considerably more data could be presented on seed and sprout treatments, those given seem to be sufficiently conclusive. The effectiveness of the fungicides that have proven to be the best in these tests has been further confirmed by their general acceptance and commercial performance in New Jersey during the last 7 or 8 years.

In all experiments reported herein, the sweetpotatoes selected for sprout production were severely affected by the disease, being much more severely infected than any observed in use by commercial growers. The sprouts were set in 4 randomized rows of 150 to 200 plants per treatment. No seed potato, sprout, or soil treatment was given except as shown. Scurf records were taken at harvest time on the resulting crop.

The field experiments reported were conducted in a sassafras loam, which favored the dis-

Table 4. Sweetpotato sprout treatments for scurf control.

Treatment	Percent of sweetpotatoes showing scurf								Mean radians (percent) for years
	1942	1943	1944	1945	1947	1948	1949	1950	1944, 1945, 1947, 1948, 1950
1. Check untreated	92.0	86.6	80.3	59.2	79.7	60.2	17.9	68.1	56.7
2. Semesan Bel 1-10	50.1	76.3	48.3	26.5	55.1	26.1	6.7	34.3	37.9**
3. Chloranil 8 oz. per gal.	78.7			44.2					
4. Chloranil 2 oz. per gal.					66.9	50.2	11.9	58.5	
5. Thiram 1-7 1/2	61.8								
6. Thiram 1-5	38.1	54.5	37.3	17.9	41.1	23.2	4.4	31.2	33.1**
7. Ferbam 1-7 1/2			47.0						
8. Ferbam 1-5			31.3	18.8	37.5	19.2	4.1	29.2	32.1**
9. Dichlone 1-5			38.3	17.3	47.1	47.7		50.2	39.0**
10. Ziram 1-5				23.3					
11. Nabam 1 pt.-16, plus zinc sulfate 1/2 lb., lime 1/2 lb.				23.5					
12. Chloranil 1-8; Ferbam 1-5				21.3				39.8	
13. Zineb 1-5						17.9	3.4		
14. Captan 1-5						34.7	12.6		
15. Puratized Agricultural 1-1000						17.1	3.3	40.8	
L.S.D. Mean radians - 5% level									5.1
L.S.D. Mean radians - 1% level									7.1

** Significant over untreated check at 1% level.

ease. For example, in 1947 sprouts from the same source were planted in a sassafras loam at the College Farm and in a sandy loam in South Jersey. Untreated sprouts produced a crop showing 79.7 percent diseased sweetpotatoes in the sassafras loam and 44.1 percent in the sandy loam. With Semesan Bel treatment 55.1 percent scurf resulted in the heavier soil and only 9.4 percent in the sandy loam. It appears that materials providing significant protection under the severe conditions of these experiments would come close to eliminating scurf in the light sandy sweetpotato areas of South Jersey.

Seed Treatment

In all seed potato treatment experiments the roots were either dipped in one of the fungicides or bedded without treatment; the resulting sprouts were planted without further treatment. In these studies borax at 1 pound in 5 gallons of water retarded sprout emergence by 3 to 5 days as compared with the untreated sweetpotatoes. Borax 1-10, ferbam, thiram, and dichlone-treated sweetpotatoes have shown no tendency toward delayed sprout emergence. The borax 1-5 treatment also showed definite toxicity, expressed in a black netted appearance chiefly at the edges of the leaves due to blackening of the veins in that area. Within a few days after the appearance of the vein discoloration the affected portions die. Leaves of sprouts from boron treated roots often are crinkled and show a dark bluish color. Injury has been more pronounced in light sands than in a loamy sand (2). Only the dark bluish color of foliage has been observed when borax was used at the rate of 1-10.

From the data recorded in Tables 1 and 2 it is apparent that Semesan Bel and borax 1-10 treatments were not very effective in reducing scurf development; however, borax 1-5, ferbam, and thiram proved to be more effective.

Plant Bed Treatment

During the past 8 years ferbam at the rate of 500 pounds per acre has been raked into the surface soil of the plant bed immediately following the bedding of the sweetpotatoes. From these data (Table 3) it can be seen that the ferbam soil treatment was probably more effective than Semesan Bel seed sweetpotato dip in controlling scurf. The ferbam soil treatment was mixed through the soil in 1948 and 1949 and only in the top inch or so of the soil during the remaining years. From Table 2 it can be seen that the ferbam soil treatment was highly significantly better than the check treatment in 1952 and just missed being a signficant improvement over the check in 1951.

Sprout Treatments

In all the sprout treatment experiments reported here, the seed used was bedded (Louis Sanguinetti's at Minotola) without seed or soil treatment. To avoid variation the resulting sprouts were divided between the treatments used, treated with one of the fungicide dip treatments, and set in the field at the College Farm.

The plants in most treatments started well and showed no retardation when compared with the untreated sprouts. This was not true, however, in most seasons for the Semesan Bel-treatment, which in some seasons retarded plants for as much as 2 to 3 weeks after setting. In 1945 the Dithane treatment also gave some plant retardation. In 1947, in an experiment at Coy's farm in Minotola the ferbam-treated plants were a darker green than were the plants in the remaining treatments. This darker color persisted for nearly 6 weeks after setting.

In these experiments plants from each treatment were dug on the second to fourth day after setting, for root observations. In all instances it was found that the Semesan Bel treatment destroyed all root hairs and secondary roots. In many instances this treatment also produced browning and pitting of the main sprout. The nabam, zinc sulfate and lime treatment produced destruction of the secondary rootlets in 1945. The other materials used in these tests have shown no tendency to produce root injury. On examining plants from the chloranil, ferbam, thiram, dichlone, zineb, captan (SR 406), and Puratized Agricultural treatments, many of the secondary roots were found to be white and functional.

The scurf data, secured from an examination of the sweetpotatoes at harvest time, are recorded in Tables 4 and 5. From these data it is clear that chloranil has very little value in scurf control. This is unfortunate since this fungicide is one of the best against stem rot. The performance of Semesan Bel likewise has been disappointing through these experiments, whereas that of dichlone was found to be inconsistent. Although Puratized Agricultural has

Table 5. Sweetpotato sprout treatments for scurf control.

Treatment	1951		1952	
	Weighted average sweetpotatoes showing scurf	Mean radians	Weighted average sweetpotatoes showing scurf	Mean radians
	Percent		Percent	
1. Check	79.6	63.8	23.3	27.9
2. New improved Semesan Bel 1-10	56.7	50.7**	9.1	17.6
3. Tag 1-1000			6.0	14.1*
4. Thiram 1-5	45.2	41.1**	1.3	7.0**
5. Ferbam 1-5	39.4	33.6**	3.5	10.8**
6. Ferbam 1 lb., chloranil 10 oz., water 5 gals.	44.8	43.3**	3.5	10.7**
7. Thiram 2-5			1.5	6.9**
8. Ferbam 2-5	24.4	28.2**	1.8	6.6**
9. Ferbam 1, thiram 1, water 5 gals.	21.1	26.3**	2.6	7.6**
10. Thiram 1 lb., chloranil 10 oz., water 5 gals.			1.5	7.0**
L.S.D. Mean radians 5% level		8.4		11.5
L.S.D. Mean radians 1% level		11.4		15.5

* Significant over untreated check at the 5% level.
** Significant over untreated check at the 1% level.

Table 6. Effect of sprout treatments on yields of sweetpotatoes.

Treatment	Average yields in bushels per acre			
	1945	1947	1948	1945, 1947, 1948
1. Check	138	319	171	209.3
2. Semesan Bel 1-10	133	300	176	203.0
3. Chloranil 2 oz. per gal.	165	335	169	223.0
4. Thiram 1-5	177	363	176	238.7*
5. Ferbam 1-5	155	362	190	235.7
6. Dichlone 1-5	141	358	141	213.3
7. Ziram 1-5	101			
8. Chloranil plus ferbam	166			
9. Zineb 1-5			184	
10. Puratized Agricultural 1-1000			138	
11. Nabam 1 pt.-16 gals. water, zinc sulfate 1/2 lb., lime 1/2 lb.	124			
L.S.D. at 5% level				33.9

*Significant over Semesan Bel at the 5% level.

shown promise, the best all around sustained performance was achieved by Tersan 1-5 and ferbam 1-5. These two materials performed well either alone or in combination with each other or chloranil. Under severe disease conditions thiram or ferbam dips may be safely increased in concentration to 2 pounds in 5 gallons of water.

The yield data, Table 6, provide further evidence of the absence of sprout injury from the use of such materials as thiram, ferbam, chloranil, and perhaps zineb. From the data in this Table it will be noted that at the 5% level the yield for the thiram treatment is significantly greater than that for the Semesan Bel treatment.

Literature Cited

1. Daines, Robert H. 1942. Scurf, black rot, and stem rot of sweetpotatoes. New Jersey Agr. Exp. Sta. Circular 437.
2. _____. 1944. Borax dip of sweetpotatoes safened by the use of calcium salts in the bedding soils. Plant Dis. Reptr. 28: 312.
3. _____. 1943. Thiosan (tetramethyl thiuramide sulfide) and scurf control of sweetpotatoes. Phytopath. 33 (5).
4. Martin, Wm. H. 1928. Sweetpotato disease control studies. New Jersey Agr. Exp. Sta. Ann. Rept. pp. 257-262.
5. Newhall, A. G., Charles Chupp, and C. E. F. Guterman. 1931. Soil treatments for the control of diseases in the greenhouse and seed bed. Cornell Extension Bull. 217.
6. Poole, R. Frank. 1922. Recent investigations on the control of three important field diseases of sweetpotatoes. New Jersey Agr. Exp. Sta. Bull. 365.
7. _____. 1922. Sweetpotato diseases in New Jersey. New Jersey Agr. Exp. Sta. Cir. 141.
8. _____. 1926. The effect of organic mercury compounds, mercuric chloride and formaldehyde on the control of the scurf or stain disease of sweetpotatoes. New Jersey Agr. Exp. Sta. Ann. Rept. pp. 352-355.
9. Taubenhaus, J. J. 1916. Soil stain, or scurf, of the sweetpotato. Jour. Agr. Res. 5 (21).
10. Weimer, J. L. 1921. Reduction in the strength of the mercuric chloride used for disinfecting sweetpotatoes. Jour. Agr. Res. 21 (8).

DEPARTMENT OF PLANT PATHOLOGY, NEW JERSEY AGRICULTURAL EXPERIMENT STATION, NEW BRUNSWICK

TWO UNUSUAL DISEASES OF SHALLOT

E. C. Tims

In the spring and early summer of 1955, two rather unusual diseases of shallot were observed in South Louisiana. Sclerotium rolfsii Sacc. (Corticium rolfsii Curzi) has been observed occasionally on shallots late in the season after the weather has gotten hot. Fusarium bulb rot also occurs to a very limited extent in certain seasons. As a rule,however, neither of these diseases is of any serious consequence in shallots. There was a period of unseasonably warm weather in April that probably accounts in part for the unusual occurrence of the two diseases this year.

During the past season S. rolfsii caused serious losses in the shallot breeding plots at Baton Rouge in April and early May. Many of the lots were seriously damaged before the normal time of maturity. Softening and general disintegration of the outer scales of infected bulbs was followed by a luxurious development of sclerotia on the dead tissues. The disease also caused some slight losses in commercial seed shallot fields.

During the latter part of June 1955 some diseased shallot sets were sent in to the Plant Pathology Department at Baton Rouge by the county agent at Thibodaux, Louisiana. The decaying shallots had become softened by bacterial soft rot before they reached our office, but there was evidence of a basal rot that resembled Fusarium bulb rot. This type of rot has been observed in shallots to a limited extent for many years, but usually it is of minor importance. A few days later several lots of shallots in storage in the Thibodaux area were examined. These bulbs had been grown near Evergreen, Louisiana in an area where seed sets are commonly grown. They were large and apparently healthy bulbs when harvested. They had been pulled and dried in the field for 5 to 6 days before being stored.

Shallot sets for seed purposes are usually dried several days in the field and then stored in barns or outhouses on the individual farm where they are to be planted. The sets are spread out in a layer 2 to 3 inches thick on wooden floors or wire screens, where they remain during the summer and early fall from May or early June until September or even until late in the winter, depending upon when the grower wants to plant them. Under normal conditions the shallot sets keep remarkably well during the hot, damp summer months and often until late fall. There may be as high as 40 to 50 percent shrinkage in weight during the storage period, but the bulbs are usually almost completely free of fungus rots. An occasional bulb may be found affected by Botrytis, Aspergillus, Penicillium, or Fusarium.

Conditions were somewhat different in 1955. Large numbers of sets were affected with a white, dry basal rot. Infection apparently began at the base of the bunch and spread upward into the individual bulbs. All stages of the disease were observed from early infection to complete rotting of the sets. The decayed areas were dry, spongy and light in color. In some bulbs there was a slight pink color caused by masses of Fusarium spores. It was estimated that 25 percent of the sets were affected in the lot of about 12,000 pounds of shallots from one grower.

A number of cultures of Fusarium were obtained from the infected shallot bulbs. They will be tested later.

DEPARTMENT OF BOTANY, BACTERIOLOGY AND PLANT PATHOLOGY, LOUISIANA STATE UNIVERSITY, BATON ROUGE, LOUISIANA

LEAF SPOT OF PARSNIP CAUSED BY THE FUNGUS CERCOSPORELLA PASTINACAE KARST.[1,2]

Emil F. Guba

Cotton (1918) described the fungi Cercosporella pastinacae Karsten (1884) in association with Ramularia pastinacae Bubak (1903) in the same necrotic spots in parsnip leaves. Sometimes Cercosporella was not mixed with Ramularia. Cotton considered them distinct pathogens. Lindroth (1902) saw Ramularia in Karsten's specimens, i.e. 1- 2-celled rod-shaped conidia, although Karsten's description refers only to long attenuated conidia, 50-90 x 2 µ. The combination Ramularia pastinacae (Karst.) Lindr. & Vestergr. was made.

Solheim (1930) proposed the new name Cercospora pastinacina Solheim for Cercosporella pastinacae Karst. based on Ell. & Ev. Fung. Col. 885b, London, Ontario, Canada, designated Cercospora apii Fres. & Thümen, Myc. Univ. 1169, Bayreuth, Bavaria, designated Cercospora apii Fres. var. pastinacae-sativae. The collection Ell. & Ev. 885b shows from my study a mixture of Ramularia and Cercosporella conidia. Thümen Myc. Univ. 1169 in the Farlow herb., Harvard Univ., is without fungus. The collection examined by Ellis and Everhart (Journ. Myc. 1: 36-37, 1885) also was reported without fungus. Solheim also refers to Saccardo Syll. Fung. 4: 219, 1886, Kirchner, Krank. u. Beschäd. Land. Kult. Pflanz. 1906, p. 396, Lindau, Rab. Krypt. Fl. 8: 424, 1907, and Cotton, Kew Bul. Misc. Inf. 1918, p. 19, fig. 2, -- references which describe a fungus with many septate, long, attenuated conidia called by all four authors Cercosporella pastinacae Karst.

Conners and Savile (Canadian Plant Dis. Surv. 23: 1943, XVIII, 1944, p. 54) reported that monospore cultures of Ramularia and Cercosporella yielded the same fungus. Ramularia predominated in the specimens examined and Cercosporella and Ramularia conidia were attached to conidiophores in the same tuft. They asserted that if the two forms prove to be distinct species Ramularia is without a name as R. pastinacae Bubak 1903 is a later homonym.

Chupp (1953) reported that all the American collections marked Cercosporella pastinacae were either Cercospora pastinacae (Sacc.) Peck or Ramularia pastinacae, and asserted that Solheim's nomenclature was doubtful. The Cercospora is a distinct parsnip leaf-spotting pathogen and irrelevant to the subject at hand.

The following collections deposited in the Farlow Herbarium, Harvard University, host Pastinaca sativa, were examined for Ramularia and Cercosporella:

Ellis & Ever. Fung. Col. 885b, Cercospora apii Fres., London, Ontario, Canada, August, 1895, J. Dearness. Both Cercosporella and Ramularia are present here.

Brenckle, F. Dakotenses, 447, Ramularia pastinacae Bubak, Kulm, North Dakota, July 8, 1916, J. F. Brenckle. Both Cercosporella and Ramularia are present here.

Vestergren. Micr. rariores sel. 1549, Ramularia pastinacae (Karst.) Lindr. & Vesterg., Bohemia, Velenka ad Sadska, July 27, 1902, Fr. Bubak. Only Ramularia spores were observed here.

Vestergren, Micr. rariores sel. 1698, Ramularia pastinacae (Karst.) Lindr. & Vesterg., Suecia, ad Tranebergsbro prope Stockholm, 9, 1913, Tycho Vestergren. Only Ramularia was found here.

Herb. Myc. Romanicum, Prof. Dr. Tr. Savulescu Fasc. XIII, No. 627, Ramularia pastinacae Bubak, Muntenia, Pasarea, Montenegro, May 25, 1932, Tr. Savulescu et C. Sandu. Both Cercosporella and Ramularia are present.

Herb. Myc. Romanicum, Prof. Dr. Tr. Savulescu Fasc. VI, no. 286, Ramularia pastinacae Bubak, Banat, Severin-Poarta, June 17, 1932. Both Cercosporella and Ramularia are present.

Kabat et Bubak, F. Imp. Ex. 741, Ramularia pastinacae Bubak, Topcidersko bei Belgrad, Serbia, June 13, 1910, N. Ranojevic. Only Ramularia was found.

Allescher & Schnabel, F. Bavarici 884, Ramularia pastinacae Bubak (Cercosporella pastinacae Karst.), Unterfranken; Gerolzhofen, Oberschwarzach, Ziegelrassen, July 1905, A. Vill. Both Cercosporella and Ramularia are present here.

---

[1] Contribution No. 1013, Massachusetts Agricultural Experiment Station.

[2] The writer is indebted to John A. Stevenson, Principal Mycologist in Charge, The National Fungus Collections, U. S. Department of Agriculture for proof-reading the manuscript.

Other relevant examples involving a Cercosporella - Ramularia complex have appeared in the literature. Plakidas (1937) reported that the pathogen involved in the rosette disease of blackberry and dewberry is Cercosporella rubi (Wint.) Plakidas (1937) and not Ramularia rubi (Wint.) Wollenweber (1917). Both occur in association with the disease. Gregory (1939) considers Ramularia vallisumbrosae Cav. (1899) and Cercosporella narcissi Boud. (1901) names for the same fungus. Cultures from amerospores, phragmospores, and scolecospores yielded the same fungus, and inoculations of the host reproduced the same disease. Gregory preferred to retain the original name R. vallisumbrosae Cav. Moore (1941) has reported a similar combination of spore forms constituting the fungus Ramularia primulae Thüm.

In my frequent examinations of specimens of the parsnip leaf spot disease in Massachusetts, both Cercosporella and Ramularia are in constant association. It is clear that we are concerned with just one pathogen. The name Cercosporella pastinacae Karst., the original name, should be preserved, even in the rare presence of the Ramularia conidial form.

The names Ramularia pastinacae (Karst.) Lindr. & Vestergr., Ramularia pastinacae Bubak, and Cercospora pastinacina Solheim should be placed in synonymy.

Literature Cited

1884. Karsten, P. Hedwigia 23: 63.
1902. Lindroth, J. I. Acta Soc. Faun. Flor. Fenn. 22 (2) 8.
1903. Bubak, Fr. Sitzber. Böhm. Ges. Wiss. Prague p. 19.
1918. Cotton, A. D. Bull. Misc. Inf. Royal Bot. Gard. Kew. No. 1, 8-21.
1930. Solheim, W. G. Illinois Biological Monographs 12: 44-45.
1937. Plakidas, A. G. Journ. Agr. Research 54, No. 4, 275-303.
1939. Gregory, P. H. Trans. Brit. Myc. Soc. 23: 24-54.
1941. Moore, W. C. Trans. Brit. Myc. Soc. 25: 208.
1943. Conners, I. L., and Savile, D. B. O. Ann. Rept. Canad. Plant Dis. Surv. 23, lit. cit. p. 54.
1953. Chupp, C. Monograph of the fungus genus Cercospora, Ithaca, New York, lit. cit. 576-577.

WALTHAM FIELD STATION, DEPARTMENT OF BOTANY, UNIVERSITY OF MASSACHUSETTS, WALTHAM, MASSACHUSETTS

CROWN WART OF LOTUS ULIGINOSUS FOUND IN OREGON[1]

John R. Hardison

Crown wart caused by Physoderma potteri (A. W. Bartlett) Karling[2] has been found on Lotus uliginosus Schk. in Coos and Tillamook Counties along the Oregon coast. Apparently this represents the first record of the fungus on L. uliginosus in the United States. The first diseased specimens were found in 1952 in a one-year old planting of L. uliginosus along the tidewater portion of the Tillamook River, several miles inland from the Pacific Ocean. This field was seeded in the spring of 1951, and by July 1952, nearly all plants in the area below the water line reached at extreme high tide were infected. No infection was apparent above the area subject to immersion by tidewater.

The stand was practically eliminated by April 1954. Loss of plants cannot be assigned wholly to the crown and bud damage initiated by crown wart, as the stand also had become thin where the plants had not been affected by the disease. On a nearby farm, infected plants were found along a short creek and in a moist, seepy depression on a hillside a considerable distance above high tide level. The owner indicated that L. uliginosus had been present in this location for many years.

FIGURE 1. Galls of Physoderma potteri on Lotus uliginosus. Healthy on left.

[1] Cooperative investigations between the Department of Botany and Plant Pathology, Oregon Agricultural Experiment Station and the Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

[2] Karling, John S. 1950. The genus Physoderma (Chytridiales). Lloydia 13 (1): 29-71.

Some of the numerous galls exceeded 2 cm in diameter, and many stems above the galls were killed (Fig. 1). In contrast, the disease, as originally described in England, on Lotus corniculatus L.[3], was scarce, caused only slight damage, and galls were relatively small, less than 1 cm. The Oregon fungus agrees with the description for P. potteri, particularly in the apical position of the haustorial pits, the irregular pattern of grooves in the wall running from apex to base, and the characteristic angular ridge that separates the more convex upper surface from the flatter under surface of the resting sporangia.

The fungus, originally described in 1926, occurred infrequently in England on L. corniculatus and caused no infection on L. uliginosus in the same location. The disease was reported to have been noticed 23 years before the causal fungus was described[3].

According to MacDonald[4] crown wart (root and crown disease) caused the greatest amount of damage among the few diseases observed on L. corniculatus in New York from 1938 to 1942. The disease occurred in isolated areas and was largely confined to moist soils. The causal organism was referred to Urophlyctis potteri Bartlett[4]. Occurrence of Lotus crown wart in the United States is not listed[5].

The susceptibility of L. corniculatus to the Oregon fungus and the origin of inoculum are as yet unknown. The disease appears to present an important new problem affecting utilization in wet locations of L. uliginosus, which has become a valuable forage legume along the north Pacific coast.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, OREGON AGRICULTURAL EXPERIMENT STATION, AND U. S. DEPARTMENT OF AGRICULTURE, FORAGE AND RANGE SECTION, CORVALLIS, OREGON

---

[3] Bartlett, A. W. 1926. On a new species of Urophlyctis producing galls on Lotus corniculatus Linn. Brit. Mycol. Soc. Trans. 11: 266-281.

[4] MacDonald, H. A. 1946. Birdsfoot trefoil (Lotus corniculatus L.), its characteristics and potentialities as a forage legume. Cornell Univ. Agr. Exp. Sta. Memoir 261. 182 pp.

[5] Weiss, Freeman, and Muriel J. O'Brien. 1952. Index of Plant Diseases in the United States. U. S. Dept. Agr., Plant Disease Survey Special Publication Number 1: 618-619.

A STRAIN OF XANTHOMONAS TRANSLUCENS VAR. UNDULOSA THAT INFECTS BROMUS COMMUTATUS AND BROMUS TECTORUM[1]

M. G. Boosalis[2]

Abstract

The bacterial blight disease called Xanthomonas streak was found on two common winter annual brome weeds, Bromus tectorum L. and Bromus commutatus L. The incitant was identified as a physiologic strain of Xanthomonas translucens var. undulosa. This brome strain of var. undulosa differs from the wheat strain in that it is much less virulent on wheat and barley but considerably more virulent on B. commutatus, B. tectorum, and B. secalinus. Results from greenhouse studies indicated that the brome strain probably does not infect cereals in the field, and that it is of minor importance in the development of epidemics of Xanthomonas streak on cereals. The pathogen overwinters on infected tissues of B. tectorum and B. commutatus.

In many of the fields surveyed in 1951 a high percentage of the two most common winter annual weeds of Nebraska, downy chess (Bromus tectorum L.) and hairy chess (Bromus commutatus L.) were severely infected with bacterial blight. The incipient and advanced symptoms on the foliage were similar to those incited by several varieties (formae speciales) of Xanthomonas translucens (L. R. Jones, A. G. Johnson, & Reddy) Dowson on cereals and grasses. For a complete description of symptoms caused by X. translucens on cereals and grasses the reader is referred to the literature (2, 7, 8, 10, 11).

Field observations suggested that the bacteria inciting leaf blight on Bromus tectorum and B. commutatus might be capable of causing Xanthomonas streak[3] on wheat or barley or both. Such a divergent host range would be of paramount importance in the epidemiology of the pathogen. Since these prevalent weeds, downy chess and hairy chess, might also harbor the bacteria from one season to the next, they could also be a source of initial inoculum from which a destructive epidemic might develop on wheat and/or barley.

These observations prompted studies to determine the specific bacteria attacking B. tectorum and B. commutatus, their host range and mode of overwintering.

Methods and Materials

Two isolates from Bromus tectorum and two from B. commutatus were obtained from bacterial exudate on leaves of plants collected from four Nebraska localities during the 1951 and 1952 growing seasons. The morphologic, cultural, biochemical and pathogenic characteristics of these isolates were compared with those of Xanthomonas translucens var. undulosa, W-1; var. cerealis, Qr-1; and var. hordei, Ba-7 (Table 1). These three varieties of X. translucens were from cultures used by the author in a previous study (2).

The 4 isolates from the 2 brome weeds were identified on the basis of pathogenicity on 18 hosts, including 3 varieties of wheat and barley and 2 varieties of oats, Bromus inermis Leyss., and rye (Secale cereale L.). Other differentials included Agropyron repens L., timothy (Phleum pratense L.), Bromus tectorum L., B. commutatus, and B. secalinus. The partial-vacuum technique recently reported by Boosalis (1) was used for inoculating the seedlings. The criterion of susceptibility was the development of linear, translucent, water-soaked lesions on the leaves of the inoculated plants, as outlined by Fang et al. (5).

Morphologic characters of the causal organism were determined by examining stained, dried preparations and unstained bacteria in hanging drops. The gram reaction was made by the Hucker modification stain (3). Staining of flagella was attained by the modified Morton's Night Blue Mordant and carbol fuchsin stain as outlined by Dowson (4). Size of bacteria was determined from measurements of cells, stained with the above mentioned flagella stain, derived from 24

---

[1] Published with the approval of the Director as Paper No. 723 Journal Series, Nebraska Experiment Station.

[2] Associate Plant Pathologist.

[3] The common name Xanthomonas streak is used througout the paper for the disease of cereals and grasses incited by Xanthomonas translucens.

Table 1. Degree of infection incited by isolates of bacteria from Bromus tectorum and B. commutatus and by four previously determined varieties of Xanthomonas translucens on cereal and grass hosts inoculated by the partial-vacuum method in the greenhouse (50 plants of each inoculated).

Host[b]	Degree of infection with isolates from barley, wheat, and brome[a]				
	hordei Ba-7	undulosa W-1	cerealis Qr-1	Brome isolates[c] Brt-1	Brc-1
WHEAT					
Cheyenne	0	4	4	2	2
Nebred	1	4	3	2	2
Thatcher	1	3	3	1	1
BARLEY					
Mars	4	4	4	2	2
Moore	4	3	3	2	2
Trebi	4	4	3	2	2
OATS					
Andrews	1	1	1		
Bonda	1	1	2	1	1
BROMUS INERMIS					
Lincoln	0	1	2	1	1
Lancaster	0	1	2	1	1
RYE					
Balbo	1	3	2	2	2
Imperial	1	2	2	2	2
TIMOTHY	0	0	0	0	0
QUACK GRASS (Agropyron repens)	0	0	4	0	0
BROMUS SPECIES					
B. tectorum	2	2	2	4	4
B. commutatus	2	2	2	4	4
B. secalinus	2	2	2	4	4

[a] 4 = severe infection; 3 = moderate infection; 2 = light infection (susceptible reaction); 1 = white, yellow or brown flecking (resistant reaction); 0 = no infection (immune reaction).
[b] Timothy was susceptible when inoculated with Xanthomonas translucens var. phleipratensis.
[c] Similar reaction was obtained with two other isolates from Bromus tectorum and B. commutatus.

hour-old cultures grown on potato-dextrose agar at 80° F.

The methods used for general bacteriological tests and for utilization of carbon compounds were those reported by Fang et al. (5). All carbon compounds included in this study were sterilized by filtering through a Seitz filter.

Pathogenicity Tests

The pathogenicity test, shown in Table 1, was repeated three times in a greenhouse maintained at about 80° F. Although symptoms of the disease were discerned about 3 days after inoculation, disease readings were not recorded until 10 days after inoculation.

On the basis of host range the isolates from Bromus tectorum and B. commutatus are similar to isolate W-1 of Xanthomonas translucens var. undulosa (Table 1). It is apparent, however, that brome isolates Brt-1 and Brc-1 are not nearly so virulent on wheat and barley as isolate W-1 of X. translucens var. undulosa. The var. undulosa from wheat, on the other hand, is weakly pathogenic to B. tectorum, B. commutatus and B. secalinus, whereas both the brome

isolates, Brt-1 and Brc-1, are strongly pathogenic on the same 3 brome species.

It is concluded from these findings that Xanthomonas translucens var. undulosa is comprised of at least two physiologic races which can be differentiated on the basis of pathogenicity on wheat, barley, and species of brome grass. Wallin (11) was the first to adduce the existence of physiologic races of X. translucens.

Morphologic Characters and General Bacteriological Tests

The comparative morphologic and cultural characters of the isolates from Bromus tectorum and B. commutatus were similar to those of Xanthomonas translucens reported by Hagborg (6) and Wallin (11).

The results from the general bacteriological tests for the production of ammonia and indole, the reduction of nitrate and litmus milk, the hydrolysis of starch, the liquefaction of gelatin, the methyl-red and Vages-Proskauer test were comparable to those listed by Fang et al. (5). All of the brome isolates produced hydrogen sulfide only after 60 days incubation.

The test for the utilization of carbon compounds included glucose, lactose, mannitol, glycerol, maltose, soluble starch, salicin, and xylose. Acid was produced by the brome isolates, Brt-1 and Brc-1, from glucose, sucrose, lactose, and xylose. No gas production by any of the brome isolates with any of the above carbon compounds was detected.

The foregoing results show that the bacterial isolates from Bromus tectorum and B. commutatus can not be differentiated from each other or from the three varieties of X. translucens used in this study on the basis of morphologic, cultural, or biochemical characters.

Recently Katznelson and Sutton (9) have attempted to use specific phages to identify varieties of X. translucens. Their results with our two brome isolates, Brt-1 and Brc-1, were not conclusive, since the workers' available strain specific phages were too specific to distinguish between varieties of Xanthomonas. It was worthy of note, however, that the brome strain of var. undulosa was lysed by polyvirulent phages which also showed activity against all known varieties of X. translucens.

Mode of Overwintering

To determine whether the pathogen overwinters on the two brome weeds, about 50 naturally infected seedlings of each of the two species were collected, transplanted into 6-inch pots, and placed outdoors in September. The control treatment consisted of placing outdoors an equal number of Bromus tectorum and B. commutatus seedlings free from bacterial infection and derived from healthy seed. The two weed hosts were considered capable of harboring the pathogen when the overwintered infected plants developed symptoms of Xanthomonas translucens infection on newly formed leaves, and after a positive identification of the pathogen was made by morphological, cultural, biochemical, and pathogenicity tests.

The following July about 2 and 5 percent of B. tectorum and B. commutatus plants, respectively, had developed typical symptoms of Xanthomonas streak. The pathogen was identified as X. translucens var. undulosa. None of the check plants of the two species of brome became infected with bacteria. These results indicate that the bacterial pathogen can overwinter on B. tectorum and B. commutatus and cause infection on the new growth of the host. It is highly probable, as was shown in studies with other hosts (2), that under favorable environmental conditions the pathogenic bacteria may be disseminated from the infected plant reservoirs to healthy plants of B. tectorum and B. commutatus and cause infection.

Discussion and Summary

This is the first time, to the writer's knowledge, that Bromus tectorum and B. commutatus are reported as natural and overwintering hosts of Xanthomonas translucens var. undulosa, the causal organism of Xanthomonas streak of cereals and grasses.

The bacterial cultures from the two weedy brome species were not nearly so virulent on wheat and barley varieties as the isolate of X. translucens var. undulosa obtained from wheat. X. translucens var. hordei, culture Ba-7 originally isolated from barley, was considerably more virulent on barley than the isolates of var. undulosa from B. tectorum and B. commutatus (Table 1). On the other hand, the weedy brome species were strikingly more susceptible to the brome isolates of X. translucens var. undulosa than to the var. undulosa strain from wheat. It is evident that X. translucens var. undulosa is comprised of at least two physiologic strains which can readily be differentiated on the basis of pathogenicity on wheat, barley, and three

weedy brome species. The extremely weak virulence of the brome strain of X. translucens var. undulosa on wheat and barley tested in the greenhouse suggests that this particular strain of undulosa does not readily infect the cereal host in the field. It would appear that the weedy brome grasses are not important hosts in the development of Xanthomonas streak epidemics on cereals. Although the artificially inoculated weedy bromes, B. tectorum, B. commutatus, and B. secalinus, were slightly susceptible to X. translucens varieties undulosa, cerealis, and hordei, none of these bromes from the field yielded the above varieties of X. translucens. Extensive field surveys coupled with pathogenicity tests, not reported here, disclosed that the primary inoculum of X. translucens inciting Xanthomonas streak of cereals comes from overwintering infected plants of barley, rye, and wheat. In some localities of Nebraska Bromus inermis and Agropyron repens may also be sources of initial inoculum.

Literature Cited

1. Boosalis, M. G. 1950. A partial-vacuum technique for inoculating seedlings with bacteria and fungi. (Abstr.) Phytopath. 40: 2-3.
2. _____. 1952. The epidemiology of Xanthomonas translucens (J. J. and R.) Dowson on cereals and grasses. Phytopath. 42: 387-398.
3. Committee on Bacteriological Technic, Society of American Bacteriologists. 1951. Manual of Methods for pure culture study of bacteria. Geneva, New York.
4. Dowson, W. J. 1949. Manual of bacterial diseases. 183 pp. The Macmillan Co., New York.
5. Fang, C. T., O. N. Allen, A. J. Riker, and J. G. Dickson. 1950. The pathogenic, physiological and serological reactions of the form species of Xanthomonas translucens. Phytopath. 40: 44-64.
6. Hagborg, W. A. F. 1942. Classication revision in Xanthomonas translucens. Canad. Jour. Res. (C) 20: 312-326.
7. _____. 1946. The diagnosis of bacterial black chaff of wheat. Sci. Agr. 26: 140-146.
8. Livingston, J. E. 1950. Small grain diseases in Nebraska in 1950. Plant Dis. Reptr. 34: 232.
9. Katznelson, H. and M. D. Sutton. 1953. Bacteriophage in relation to Xanthomonas translucens. Canad. Jour. Bot. 31: 725-728.
10. Smith, E. F. 1920. An introduction to bacterial diseases of plants 1st ed. 688 pp. W. B. Saunders Co.
11. Wallin, J. R. 1946. Parasitism of Xanthomonas translucens (J. J. and R.) Dowson on grasses and cereals. Iowa State College Jour. Sci. 20: 171-193.

DEPARTMENT OF PLANT PATHOLOGY, NEBRASKA AGRICULTURAL EXPERIMENT STATION, LINCOLN, NEBRASKA

ASSOCIATION OF DOWNY MILDEW AND ANTHRACNOSE ON OATS

Nader G. Vakili and John F. Schafer

Oat plants infected with downy mildew were observed scattered throughout low areas in a field of Newton oats near Romney, Indiana, in July 1955. Both exceptionally tall and somewhat dwarfed plants were found. Infected tall plants were 8 to 12 inches taller than normal plants and still green when the normal plants were nearly ripe. There were about 16 nodes in the culms of each infected tall plant as compared to 6 nodes in the normal plants. The panicles were severely deformed and extended out through the side of the sheaths of the flag leaves. The short infected plants occurred in areas where all of the plants had been damaged by standing water and were only slightly shorter than adjacent non-infected plants. In many instances the short infected plants had not developed panicles. Both expressions of the disease have been described from Indiana previously, but in separate seasons (2).

Sheaths and blades of infected plants had a rough texture due to distortion of the tissue associated with the presence of numerous oospores. These occurred mainly around the vascular bundles, were 57.5 microns in average diameter, thick walled, and yellow. Size, shape, and color closely resembled the description of these organs of Scleropthora macrospora (Sacc.) Thirum., Shaw, & Naras (Sclerospora macrospora Sacc.).

Large, distinct, oval to diamond-shaped lesions, 5 to 8 mm by 14 to 33 mm in size, of anthracnose were found occurring frequently on the green leaf blades of dwarfed downy mildew-infected plants. On many leaves these lesions had coalesced and covered patches of the leaf surface. The lesions had a zonate appearance due to the presence of numerous acervuli of Colletotrichum graminicola (Ces.) G. W. Wils. arranged concentrically. Acervuli were also found on the leaf sheaths and lower culms of the downy mildew-infected plants. The crown and lower culms of the plants not infected by S. macrospora also showed some degree of anthracnose infection, but no anthracnose lesions were found on the blades of these more nearly ripe normal plants. Distinct blade lesions on oats have previously been reported by Rosen (4) in Arkansas and Goto and Moore (3) in Minnesota, but had not been seen by the writers in Indiana.

Bruehl and Dickson (1) showed that C. graminicola is a high temperature organism. Distinct blade lesions commonly occur on Sudan grass, a warm temperature host, but not on rye, a cool temperature host. It is suggested that in the current observation only the downy mildew-infected oat plants were immature enough at a time of favorable warm temperature for such leaf lesions to develop.

Cross sections of the anthracnose lesions on the leaves of the downy mildew-infected plants showed an abundance of both the oospores of S. macrospora in the tissue and acervuli of C. graminicola on the upper leaf surface. The striking features of this observation were both the presence and the exceptionally large size of the anthracnose lesions on the downy mildew-infected oat leaves.

Literature Cited

1. Bruehl, G. W., and J. G. Dickson. 1950. Anthracnose of cereals and grasses. U. S. Dept. Agr. Tech. Bul. 1005.
2. Caldwell, R. M., T. R. Stanton, and R. R. Mulvey. 1949. Downy mildew of oats in Indiana. Plant Dis. Reptr. 33: 78-79.
3. Goto, S., and M. B. Moore. 1952. Some oat diseases in Minnesota 1951. Plant Dis. Reptr. 36: 69-70.
4. Rosen, H. R. 1946. Oat diseases in Arkansas, 1946. Plant Dis. Reptr. 30: 364-368.

DEPARTMENT OF BOTANY AND PLANT PATHOLOGY, PURDUE UNIVERSITY, LAFAYETTE, INDIANA

SEED TREATMENT TESTS WITH PEARL MILLET, SUDAN GRASS, AND BROWNTOP MILLET[1]

E. S. Luttrell, Loy V. Crowder, and Homer D. Wells[2]

Summary

In field tests at 5 locations in Georgia in 1953 and 1954 seed treatment with various fungicides had only a slight and inconsistent effect on emergence of Sudan grass and browntop millet. With pearl millet, seed treatment consistently tended to increase emergence, although the differences between treatments usually were not statistically significant. Treatment was most effective on lots of seed shown by laboratory germination tests and isolations to be heavily infested with molds. Use of clean seed appears to be of greater importance than seed treatment.

In 1953 a single seed treatment test with pearl millet (variety Starr), Sudan grass, and browntop millet was planted at Experiment in the Georgia Piedmont. In 1954 the same species were used in two tests planted on different dates at Experiment and in one test each at Blairsville in the Appalachian mountains, Calhoun in the limestone Valley, and Plains in the Coastal Plain (Table 1). Tift Sudan was planted in 1953, Sweet Sudan in 1954. The Starr millet seed planted in 1953 was grown at the Georgia Coastal Plain Experiment Station at Tifton. That used in 1954 was obtained from commercial sources. It proved to be of such good quality that a second lot of badly infested seed from the McCranie farm near Tifton was included in the second test at Experiment and in the Plains test. This seed is designated "Starr millet (M)." During the same period, series of tests with Starr millet were made independently at the Georgia Coastal Plain Experiment Station.

Methods

The seed was treated with Arasan and Spergon at the rate of 8 oz./100 lbs. (0.5 gm./100 gm.) and Panogen at the rate of 3/4 fluid oz./bu. (0.12ml./100 gm.). A split plot design with species as main plots and treatments as subplots was used for each test. Plots were replicated 5 times. Plantings were made with a specially fitted grain drill designed to distribute small amounts of seed uniformly throughout the row. Stand counts were made 10 to 14 days after planting. In the 1953 test both 3-row and 1-row plots were used. Rows were 20 feet long. Weighed amounts of seed were planted at the recommended rates in the 3-row plots, and the stands were sampled by counting the number of seedlings in 3-foot lengths of each row. The 1-row plots were planted with 200 seeds each, and all seedlings were counted. In the 1954 tests only 1-row plots with 200 seeds/16 ft. row were used. Forage yields were taken in the 1953 test and in the first test at Experiment in 1954.

In 1954 laboratory germination tests were made on 200 seeds from each treatment of each species (Table 3). Seeds were placed between layers of paper towelling in 150 mm Petri dishes at the rate of 50 seeds/dish. They were held in a 20° C germinator at night and at laboratory temperatures of approximately 25° C during the day. Germination counts and mold determinations were made at the end of 7 days. To determine the presence of internal molds 50 untreated seeds of each species were surface sterilized in 1:1000 mercuric chloride for 2 minutes, washed in sterile water, and planted on water agar in Petri dishes.

In the tests at the Coastal Plain Experiment Station Starr millet seed, all of which came from the McCranie farm, was treated with a number of fungicides at various rates, as indicated in Table 2. Field plots were 18 inches square and were replicated 4 times in a randomized block. Plots were planted at the rate of 100 seeds/plot with a small row seeder originally designed to place seed at a uniform depth in flats in the greenhouse. Tests were planted following rains on 3 dates in 1953 and 1 in 1954. Stand counts were made approximately 2 weeks after planting.

---

[1] Paper No. 287, Journal Series, Georgia Experiment Station; Cooperative investigation with the Georgia Experiment Station, the Georgia Coastal Plain Experiment Station, and the Field Crop Research Branch, Agricultural Research Service, U. S. Department of Agriculture.

[2] Plant Pathologist; formerly Associate Agronomist, Georgia Experiment Station; and Agent Pathologist, Field Crops Research Branch, Agricultural Research Service, U. S. Department of Agriculture, and Georgia Coastal Plain Experiment Station, respectively.

Table 1. Effect of seed treatment on emergence of forage grasses.

Location	Percent emergence											
	Starr millet				Sudan grass				Browntop millet			
	Control	Arasan	Spergon	Panogen	Control	Arasan	Spergon	Panogen	Control	Arasan	Spergon	Panogen
Experiment May 26, 1953	25	38*	35*	—	60	69	66	—	23	28	26	—
Experiment May 18, 1954	40	50	37	43	56	69	57	58	39	35	37	41
Experiment July 12, 1954 (M)	42 22	50 30	42 24	39 31	71	74	70	66	52	53	56	60
Calhoun May 24, 1954	20	26	26	25	25	39	32	32	14	13	20	18
Blairsville June 25, 1954	16	25	23	22	53	49	46	55	20	23	16	19
Plains July 13, 1954 (M)	60 27	65 40	65 35	58 39	76	78	74	77	68	81	75	75

*Significant at 5% level.

Table 2. Effect of seed treatment on the emergence of Starr millet (M) at the Georgia Coastal Plain Experiment Station.

Treatment	Rate of application	Percentage emergence from plantings on			
		6/11/53	6/25/53	7/10/53	7/9/54
Control	---	23.5	28.5	31.0	28.2
Ceresan M	1/100	19.9	19.0	18.2	31.7
Ceresan M	1/200	21.1	21.2	43.7	34.0
Ceresan M	1/400	24.2	24.7	34.2	32.7
Ceresan	1/800	--	--	41.2	30.5
Arasan	1/100	28.2	38.0	38.0	30.1
Arasan	1/200	20.5	38.5	43.0	--
Arasan	1/400	29.4	34.5	30.2	--
Semesan, Jr.	1/100	17.5	33.7	--	--
Semesan, Jr.	1/200	29.7	31.0	--	--
Semesan, Jr.	1/400	40.7	26.5	--	--
Vancide	1/100	21.4	33.0	--	--
Vancide	1/200	24.7	32.5	--	--
Vancide	1/400	23.6	34.7	--	--
Cadminate	1/100	19.4	31.0	--	--
Cadminate	1/200	12.2	33.0	--	--
Cadminate	1/400	19.0	35.5	--	--
Spergon	1/100	16.9	29.0	--	--
Spergon	1/200	20.6	35.0	--	--
Spergon	1/400	--	25.7	--	--
Crag 531	1/100	--	--	--	23.5
Crag 531	1/200	--	--	--	23.2
Crag 531	1/400	--	--	--	22.7
Crag 531	1/800	--	--	--	23.5
PMAS	1/100	--	--	--	4.0
PMAS	1/200	--	--	--	13.7
PMAS	1/400	--	--	--	20.5
PMAS	1/800	--	--	--	17.7
L.S.D. 5%		NS	4.4	9.8	8.3
L.S.D. 1%		NS	5.9	13.3	11.1

Table 3. Effect of seed treatment on germination and development of molds on seed of forage grasses in laboratory germination tests.

Species and treatment	Percent germination[a]					Percent seed infested				
	Good	Good moldy	Dying moldy	Nongerminated	Nongerminated	Curvularia	Hel. spiciferum	Hel. stenospilum	Fusarium	Undetermined
Starr millet										
Control	52.5	13	5.5	11.5	15.5	1.5	0	11	0	15
Arasan	68.5	3.5	2.5	16.5	9	0.5	0	4.5	4	5.5
Spergon	70	1	3	19	7	1	0	3	0	5
Panogen	66.5	8	3	9.5	13	3	0	9	0	10
Starr millet (M)										
Control	2	21	19.5	0.5	57	10.5	6	45.5	12.5	24
Arasan	32	2.5	6.5	27	24	2.5	1.5	12	6	16.5
Spergon	49.5	4.5	2.5	22.5	26	1.5	0	6.5	7	14.5
Panogen	30.5	8.5	4	13.5	40.5	7	0	17	11.5	16
Sudan grass										
Control	28	58:5	0	0.5	13	0	1	0	5	50.5
Arasan	91	0.5	0	8.5	0	0	0	0	0.5	0
Spergon	90	1	0	8	1	0	0	0	0.5	0
Panogen	83	9	0	8	0	0	0	0	0.5	8.5
Browntop millet										
Control	48.5	45.5	0.5	1.5	4	8.5	20	12	3	10.5
Arasan	94	2	0	4	0	0	0	0	0	2
Spergon	93.5	2.5	0	4	0	0	0	0	0	2.5
Panogen	87	9	0	3.5	0.5	0	1.5	0	0	7

[a] Good seed were considered as those which germinated and showed no sign of mold growth; good moldy seed were considered as those which germinated and developed normally but showed mold growth; dying moldy seed were considered as those which germinated but died from mold growth; nongerminated seed were considered as those which failed to germinate and had no visible mold growth; nongerminated moldy seed were considered as those which failed to germinate and were infested with mold.

Laboratory germination tests were made in 1953 to determine the effect of various fungicides on germination and on control of the most common mold (Table 4). Seeds were placed on the surface of blotters in Petri dishes at the rate of 50 seeds/dish with 4 replications. Counts were made 11 days later. In addition, isolations were made from surface sterilized seed planted on 20 percent V-8 juice agar. Isolations were attempted from 100 seeds each of lots of seed from the following sources: McCranie farm, Coastal Plain Experiment Station, and the Irrigation Station at Brawley, California (Table 5).

Results

Results of the field tests are in Table 1. In the 1953 test the results of sampling the 3-row plots planted with weighed lots of seed and the total counts of 1-row plots planted with 200 seeds were not strictly comparable. Because of the question of adequacy of sampling, the results with counted seed were considered more accurate; and these figures are reported in the Table. Results with Sudan grass and browntop millet were inconsistent. Differences between controls and treatments as great as 10 percent appeared in only 2 or 3 of the 6 tests. With Starr millet,

Table 4. Effect of seed treatment on germination of Starr millet (M) seed and inhibition of Helminthosporium stenospilum in laboratory germination tests.

Treatment	Rate of application	Percent germination	Percent seed supporting growth of H. stenospilum
Control	--	44.0	56.0
Ceresan M	1/100	65.0[a]	5.0
Ceresan M	1/200	67.5[a]	11.0
Ceresan M	1/400	62.5	24.0
Arasan	1/100	63.0	15.0
Arasan	1/200	56.5	23.5
Arasan	1/400	56.0	25.0
Semesan, Jr.	1/100	56.7	31.0
Semesan, Jr.	1/200	55.5	31.0
Semesan, Jr.	1/400	51.5	39.0
Vancide	1/100	50.5	25.0
Vancide	1/200	58.5	21.0
Vancide	1/400	52.5	28.0
Cadminate	1/100	54.0	32.0
Cadminate	1/200	63.0	31.5
Cadminate	1/400	50.0	35.5
Spergon	1/100	62.0	3.0
Spergon	1/200	59.0	7.5
Spergon	1/400	55.0	23.5
L.S.D. at 5% level		11.4	9.4
L.S.D. at 1% level		15.0	12.4

[a] Seedlings severely stunted.

Table 5. Fungi isolated from surface sterilized seed of Starr millet from three different seed sources.

Species	Percent seed infested		
	McCranie	Coastal Plain Experiment Station	California
Helminthosporium stenospilum	62	17	0
Curvularia spp.	16	8	0
Fusarium spp.	9	4	0
Alternaria sp.	2	0	1
Verticillium sp.	1	0	0
Phythium sp.	0	2	0
Trichoderma sp.	0	4	0
Aspergillus spp.	0	2	18
Penicillium spp.	0	0	2
Rhizopus spp.	0	0	4
Undetermined	6	8	1
None	4	55	74

seed treatments consistently tended to increase emergence. The differences between controls and treatments were usually greater, although they were statistically significant only in the 1953 test at Experiment. Arasan produced increases of 8 to 56 percent, Spergon increases of 0 to 44 percent, and Panogen decreases of 3 and 7 percent in 2 tests and increases of 8 to 44 percent in 4 others. Results of tests with Starr millet at the Coastal Plain Experiment Station were variable (Table 2). Statistically significant increases in emergence over controls were obtained with Arasan, Ceresan M, Spergon, Semesan, Jr., Vancide, and Cadminate in one or more tests. Ceresan M at the highest rate of application, PMAS, and Crag 531 tended to decrease emergence.

Results of laboratory germination tests are in Table 3. Only the most common seed-borne molds are listed in the table. Molds identified on Starr millet seed were Helminthosporium stenospilum Drechs., Fusarium spp., Curvularia lunata (Wakker) Boed., H. spiciferum (Bain.) Nicot[3], H. rostratum Drechs. (1.5 percent), Aspergillus sp. (4.5 to 0.5 percent), Penicillium sp. (2.5 to 0.5 percent), and Rhizopus sp. (0.5 percent). H. stenospilum produced characteristic brown streaks on the base of the seedlings and was the most important cause of death of seedlings in the laboratory tests. Bacteria were the only organisms concerned in the decay of some of the nongerminated seed. Their presence was apparently obscured by the growth of molds on many seeds since they were evident chiefly in the treated seed. There were few identifiable molds on Sudan grass seed. These included Fusarium spp., H. spiciferum, Rhizopus sp. (11 percent), Aspergillus sp. (3 percent), and Penicillium sp. (0.5 percent). Molds on browntop millet were H. spiciferum, H. stenospilum, C. lunata, Fusarium spp., and H. rostratum (1 percent). All treatments were effective in controlling surface molds. In surface sterilized seed planted on agar the percentages of seed free of molds were as follows: Starr millet -- 70, Starr millet (M) -- 16, Sudan grass -- 96, browntop millet -- 94. Molds identified and the percentages of seed on which they were present in Starr millet were H. stenospilum -- 12, Penicillium sp. -- 2, bacteria -- 8; on Starr millet (M), H. stenospilum -- 36, C. lunata -- 28, Fusarium spp. -- 14, bacteria -- 2; on Sudan grass Fusarium sp. -- 2; on browntop millet C. lunata -- 6, H. spiciferum -- 2.

In laboratory germination tests with Starr millet at the Coastal Plain Experiment Station (Table 4), all fungicides tended to increase germination and to control Helminthosporium stenospilum. Spergon, Arasan, and Ceresan M were most effective. Ceresan M at the higher rates of application caused injury to seedlings. The most frequent molds isolated from surface sterilized seed produced in Georgia were H. stenospilum, Curvularia spp., and Fusarium spp., (Table 5). These species also occur commonly as head molds of pearl millet in the field in Georgia[4]. They were not isolated from seed grown in California. Aspergillus sp. was relatively abundant on the California seed, perhaps because the seed was not properly dried.

Discussion

Seed of Sudan grass, browntop millet, and one lot of Starr millet were relatively free of molds. With this seed, fairly large percentage increases in emergence of treated seed over controls were obtained only when conditions were unfavorable for germination, as indicated by very poor stands from untreated seed. Percentage increases were greater from treatment of Starr millet seed heavily infested with molds. However, treatment did not bring the emergence of poor seed up to the level of emergence of untreated clean seed. Although some benefit from treatment might be expected under some conditions even for seed of good quality, it seems that seed treatment generally would be of less importance than the production of clean seed either by the control of head molds in the field or by growing seed in areas in which these molds do not occur.

GEORGIA EXPERIMENT STATION, EXPERIMENT, GEORGIA COASTAL PLAIN EXPERIMENT STATION, TIFTON, GEORGIA, AND THE AGRICULTURAL RESEARCH SERVICE, TIFTON

---

[3] Nicot, Jacqueline. 1953. Un Helminthosporium saprophyte du sol; Helminthosporium spiciferum (Bain.) nov. comb. Oesterreich. Bot. Zeitschr. 100: 478-485. This fungus (Syn. Brachycladium spiciferum Bain., Curvularia spiciferum (Bain.) Boed.) seems properly placed in Helminthosporium. H. tetramera McKinney is a closely related and probably synonymous species.

[4] Luttrell, E. S. 1954. Diseases of pearl millet in Georgia. Plant Dis. Reptr. 38: 507-514.

EVALUATION OF VARIOUS FUNGICIDES AND APPLICATION SCHEDULES IN THE CONTROL OF DISEASES OF CHERRY NURSERY STOCKS[1]

R. M. Gilmer

SUMMARY

The results of 5 years of fungicide tests for control of powdery mildew and leafspot of cherry nursery stocks demonstrated that both timing of the initial application and choice of fungicide were critical for disease control. Under normal western New York conditions, the initial application should be made 10 to 14 days after budbreak, i. e., usually about June 10 to 15.

A combination of Actidione (2 ppm) and sulfur (2 to 5 lbs.-100) afforded outstanding control of both diseases when used in a 4-application schedule with applications at 14-day intervals. Actidione (2 ppm) in the same schedule gave excellent leafspot control, but control of powdery mildew, while comparable to that obtained with copper fungicides, was not highly satisfactory.

Copper fungicides at rates as low as 0.4 lbs. actual metallic copper per 100 gallons usually gave good control of leafspot but poor control of powdery mildew.

None of the remaining fungicides tested gave acceptable control of both diseases in a 4-application schedule.

INTRODUCTION

In the western New York nursery area the principal diseases of cherry nursery stocks are leafspot (Coccomyces hiemalis Higgins) and powdery mildew (Podosphaera oxyacanthae (DC) DeBy.). Leafspot is injurious to sweet and sour cherries and to mazzard and mahaleb understocks on which cherries are propagated. Serious injury from powdery mildew is usually confined to sour cherries, although the disease occurs to some extent on sweet cherries and mazzard understocks.

Major injury from leafspot is incurred during May, June, and early July in western New York, after which time further progress of the disease is usually checked by dry weather. Outbreaks of leafspot are also common in late September, but defoliation at this time of year is probably beneficial since it hastens the maturity of the trees. The early season infections are capable, however, of reducing the caliper and resultant grade of affected trees, and understocks with heavy infections may become refractory to budding because of cessation of growth.

Powdery mildew of cherries is typically a disease of mid-summer (July and August) in western New York. The fungus flourishes during periods with low rainfall, particularly if the nights are cool with heavy dews. Severe infections reduce normal terminal elongation, but unlike apple mildew, systemic infections of the growing points are rare,.

Although copper fungicides have given commercially acceptable control of leafspot in cherry nursery stocks, control of powdery mildew with these materials has never been highly satisfactory. Tests were commenced in 1951 to determine whether other fungicides or fungicide combinations would give superior control of both diseases[2].

EXPERIMENTS

1951--Development and severity of both leafspot and powdery mildew were rated as about average for the Dansville nursery area.

Initial screening tests of a number of fungicides were begun early in the season to obtain preliminary data on injury and leafspot control. The most promising materials were then tested in a replicated block of Montmorency sour cherry. The test block consisted of 2-year trees that had not been sprayed the previous season. The initial fungicide application was made on June 26, a time when a fairly heavy leafspot infection was already evident. Two additional applica-

1 Approved by the Director of the New York State Agricultural Experiment Station for publication as Journal Paper No. 1015.

2 The program was originally initiated by Dr. H. C. Young, Jr., formerly of this Station, who performed the original fungicide screening tests in 1949 and 1950.

Table 1. Effect of various fungicides on defoliation and control of leafspot and powdery mildew of Montmorency sour cherry, Dansville, 1951.

Fungicide	Total foliation[a]		Per cent defoliation		Per cent leaves with lesions		Per cent leaves injured[b]		Mildew rating[c]
	7/17[d]	8/28	7/17	8/28	7/17	8/28	7/17	8/28	9/5
Ferbam 3-100 (1st application) Ferbam 1½-100 (2nd, 3rd application)	2212	2281	13	23	35	49	49	72	34
Bordeaux 1½-6-100	2340	2345	11	12	26	25	37	37	24
Bordeaux 3-6-100	2283	2296	9	10	26	28	34	38	22
Phenyl mercury 1 pt.-100	2310	2310	7	8	26	40	33	48	34
Control	2285	2308	18	64	43	34	61	98	38
LSD 19:1	NS	NS	7	8	7	15	9	18	7
LSD 99:1	NS	NS	9	11	10	20	13	24	10

[a] Actual number of leaves produced on 100 terminals.

[b] Summation of leaves off plus leaves with lesions.

[c] Average percent leaves per terminal mildewed.

[d] Dates on which counts were made.

Table 2. Effect of various fungicides on caliper, height, and percentage Grade 1 trees of Montmorency sour cherry, Dansville, 1951.

Fungicide	Rate	Mean caliper[a]	Mean height[b]	Per cent Grade 1 trees[c]
Ferbam	3-100[d] 1½-100	10.3	45	87
Bordeaux	1½-6-100	13.2	48	94
Bordeaux	3-6-100	12.9	47	92
Phenyl mercury	1 pt.-100	9.9	41	81
Control	-	10.0	43	83

[a] Caliper is expressed in sixteenths of an inch diameter measured at a point 3 inches above the union of scion and understock.

[b] Height is expressed in inches from point of union to tip of central leader.

[c] Grade 1 trees are those with a minimum caliper of 9/16 inches and a minimum height of 42 inches.

[d] Lbs. per 100 gallons.

tions were made at 14-day intervals.

Of the materials included in this test, only the two concentrations of Bordeaux mixture afforded satisfactory leafspot control (Table 1). Ferbam, in the schedule employed, failed to provide acceptable leafspot control, and phenyl mercury caused intolerable injury which became more severe as the season progressed. Only the two Bordeaux concentrations gave any degree of mildew control and even this control was only fair (Table 1). The effect of these fungicides on growth of the trees is evident in Table 2.

These data, in addition to indicating differences in performance of the various fungicides, emphasized the fact that the initial application was made too late for good leafspot control.

1952--The 1952 experiments were primarily designed to determine the effects of timing of the initial fungicide application on control of leafspot. The season was unfavorable for the development of either disease in the Dansville area. The data obtained are not of sufficient interest to justify their inclusion here, but the performance of copper fungicides was again superior to the organic materials tested.

1953--The season was particularly favorable for leafspot, but powdery mildew did not become evident until late in the season and caused little damage.

Although the 1951 and 1952 experiments had indicated that the initial fungicide application should be made in early June, the press of spring planting frequently delayed grower applications until late June. To explore the timing of initial application further, the experimental plots were sprayed at the time that the first grower applications were being made (June 29). Only two additional applications were made spaced at 21-day intervals to determine whether a 3-application program with 21-day intervals would prove as satisfactory as a 4-application schedule spaced at 14-day intervals.

Under these experimental conditions, the performance of a fixed copper (Tennessee "26") was fair, but leafspot injury had reached almost 20 percent by August 25 (Table 3). Captan in the same schedule failed to provide adequate control of leafspot, and it became evident that the 21-day interval was too long for this fungicide.

In contrast to the 1951 experiments, superior control of leafspot was reflected only by in-

Table 3. Effect of two fungicides on growth and defoliation of Montmorency sour cherry, Dansville, 1953.

Fungicide	Total foliation[a]	Per cent defoliation	Per cent leaves with lesions	Per cent leafspot injury[b]
		June 30[c]		
Fixed copper (1½-3-100)	1657	2	10	12
Captan (1½-100)	1636	2	9	10
Control	1642	2	7	9
LSD 19:1	NS	NS	NS	NS
LSD 99:1	NS	NS	NS	NS
		July 22[c]		
Fixed copper	1859	3	9	12
Captan	1886	5	24	29
Control	1698	23	49	72
LSD 19:1	80	4	12	14
LSD 99:1	133	6	21	23
		August 25[c]		
Fixed copper	1875	5	14	19
Captan	1895	11	51	63
Control	1741	75	22	96
LSD 19:1	70	10	24	15
LSD 99:1	116	17	40	25

[a] Actual number of leaves per 100 terminals.

[b] Summation of leaves off plus leaves with lesions.

[c] Dates on which counts were made.

creased height of the trees (Table 4). Low soil fertility undoubtedly limited growth in this experiment.

1954--The experimental plots were shifted from the Dansville nursery area to Geneva. Both leafspot and powdery mildew were extremely damaging in the Dansville area, but, unfortunately, only mildew was severe in the Geneva plots.

When it became evident that leafspot would be light in the experimental plots at Geneva, data were taken in grower-sprayed blocks at Dansville. These data require considerable caution in interpretation, since some of the variation is unquestionably due to the effects of location. However, wide differences in leafspot and mildew control reflect the effects of timing or choice of fungicide. Grower schedules and materials are given in Table 5, and data on the control of leafspot and mildew are given in Tables 6 and 7, respectively.

Table 4. Effect of two fungicides on caliper, height, and number of Grade 1 trees of Montmorency sour cherry, Dansville, 1953.

Fungicide	Rate	Mean caliper[a]	Mean height[b]	Per cent Grade 1 trees[c]
Fixed copper	1½-3-100[d]	10.9	39	83
Captan	1½-100	9.9	35	76
Control		9.9	33	77
LSD 19:1		NS	2	NS
LSD 99:1		NS	4	NS

[a] Caliper is expressed in sixteenths of an inch diameter measured at a point 3 inches above the union of scion and understock.

[b] Height is expressed in inches from point of union to tip of central leader.

[c] Grade 1 trees are those with a minimum caliper of 9/16 inches and a minimum height of 42 inches.

[d] Lbs. per 100 gallons.

Table 5. Fungicides and application dates employed in commercial nurseries, Dansville, 1954.

	Fungicides	Rate	Dates of application
A.	Ferbam Fixed copper	2-100 3-3-100	June 17 July 7, July 25
B.	Actidione	2 ppm	June 15, July 1, July 17, August 2, August 21
C.	Actidione plus micronized sulfur	2 ppm 5-100	Dates as in B
D.	Bordeaux	3-3-100	July 1, July 22, August 5
E.	Captan Karathane	1½-100 2-100	June 20, July 7, July 21, August 11 September 4
F.	Bordeaux	8-8-100	July 2, July 17, August 4
G.	Ferbam	2-100	July 9

Table 6. Leafspot injury on commercially-sprayed Montmorency sour cherry, Dansville, 1954.

Fungicide	Rate	Nursery	Per cent leaves with lesions		Per cent defoliation		Total leafspot injury[a]	
			7/15[b]	9/1	7/15	9/1	7/15	9/1
Ferbam Fixed copper	2-100 3-3-100	A	9	17	2	9	11	26
Actidione	2 ppm	B	0	1	0	0	0	1
Actidione- Sulfur	2 ppm 5-100	C	0	tr	0	0	0	tr
Bordeaux	3-3-100	D	14	19	6	23	20	42
Captan Karathane	1½-100 2-100	E	7	20	3	12	10	32
Bordeaux	8-8-100	F	6	11	2	42	8	52
Ferbam	2-100	G	17	42	8	45	24	87

[a] Summation of leaves off plus leaves with lesions.

[b] Dates on which counts were made.

Table 7. Effect of fungicides on control of powdery mildew of Montmorency sour cherry, Dansville, 1954.

Fungicide	Nursery[a]	Per cent terminals with mildew		Per cent leaves per terminal mildewed	
		7/16[b]	9/5	7/16	9/5
Ferbam 2-100 Fixed copper 3-3-100	A	84	100	19	37
Actidione 2 ppm	B	74	100	17	40
Actidione 2 ppm- Sulfur 5-100	C	17	5	9	7
Bordeaux 3-3-100	D	80	100	16	36
Captan 1½-100 Karathane 2-100	E	81	100	33	59
Bordeaux 8-8-100	F	73	100	19	29
Ferbam 2-100	G	93	100	31	44

[a] Refer to Table 5 for timing of applications.

[b] Dates on which counts were made.

Table 8. Effect of fungicides on control of leafspot of Montmorency and Morello sour cherry, Geneva, 1954.

Fungicide	Per cent leaves with lesions				Per cent defoliation				Total leafspot injury[a]			
	Montmorency		Morello		Montmorency		Morello		Montmorency		Morello	
	7/20	9/11	7/20	9/11	7/20	9/11	7/20	9/11	7/20	9/11	7/20	9/11
Actidione 2 ppm	2	3	1	2	tr[b]	tr	tr	tr	3	3	1	2
Captan 1½-100	7	9	7	10	3	5	3	6	9	14	10	16
Bordeaux 1½-3-100	5	7	6	10	2	5	2	6	8	12	8	15
Control	14	27	15	30	4	16	5	16	17	43	20	46
LSD 19:1	5	8	5	9	NS	NS	NS	NS	6	10	7	11
LSD 99:1	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

[a] Summation of leaves off plus leaves with lesions.

[b] Less than 0.5 percent.

Table 9. Effect of fungicides on control of powdery mildew of Montmorency and Morello sour cherry, Geneva, 1954.

Fungicide	Per cent terminals with mildew				Per cent leaves per terminal mildewed			
	Montmorency		Morello		Montmorency		Morello	
	7/21	9/11	7/21	9/11	7/21	9/11	7/21	9/11
Actidione 2 ppm	71	100	76	100	20	38	27	36
Captan 1½-100	84	100	85	100	27	46	30	49
Bordeaux 1½-3-100	75	100	71	100	19	31	24	32
Control	97	100	93	100	32	44	32	47
LSD 19:1	11	NS	10	NS	9	7	8	8
LSD 99:1	NS	NS	NS	NS	NS	NS	NS	NS

Table 10. Effect of fungicides on control of leafspot and powdery mildew of Montmorency sour cherry, Geneva, 1955 [a]

Fungicide	Percent leaves with lesions	Percent defoliation	Total leafspot injury	Percent terminals mildewed	Percent leaves per terminal mildewed
Actidione 2 ppm	2	tr[b]	2	88	42
Actidione 2 ppm-Sulfur 2-100	2	1	3	8	20
Bordeaux 1 1/2-3-100	5	3	8	83	45
Control	11	9	20	96	68

[a] Data taken August 9.

[b] Less than 0.5 percent.

In both schedules where Actidione was used (Nurseries B and C), outstanding control of leafspot was obtained (Table 6). The Fermate-fixed copper schedule used by Nursery A gave fair control, while captan in a 4-schedule application (Nursery E) was almost as satisfactory. If the June 15 application was omitted, leafspot control was reduced appreciably even though effective fungicides such as Bordeaux 3-3-100 (Nursery D) and 8-8-100 (Nursery F) were used. Much of the defoliation in the latter block was due to copper injury.

The formulation containing Actidione plus micronized sulfur gave outstanding control of powdery mildew (Nursery C, Table 7). Actidione alone was comparable to Bordeaux 3-3-100 or fixed copper 3-3-100, but inferior to Bordeaux 8-8-100 in mildew control. Captan again gave little control of powdery mildew and the additional single Karathane application was applied too late to give any appreciable control (Nursery E, Table 7).

Data obtained in the experimental plots at Geneva duplicated those obtained at Dansville. In a 4-application schedule (14-day intervals) begun on June 12, the performance of Actidione was again outstanding in regard to leafspot control (Table 8). Control of powdery mildew with Actidione was about equal to that obtained with fixed copper (Table 9).

1955--The same experimental block at Geneva sprayed as budlings in 1954 was used in the 1955 experiments. The season was extremely unfavorable for leafspot and development of powdery mildew was relatively slight. A 4-application schedule with 14-day intervals was used with the initial application made on June 16.

Although none of the materials received a severe test, their rank in leafspot and mildew control was essentially that found in 1954 (Table 10).

DISCUSSION

The data presented clearly demonstrate two principal factors in control of leafspot and powdery mildew of cherry nursery stock -- choice of fungicide and proper timing of the initial application.

Of the materials tested, Actidione has given outstanding control of leafspot and is perfectly compatible with sulfur for increasing the degree of mildew control. Although the material has been tested for only two seasons, its performance both years at different locations was exceptional.

Copper fungicides, in general, have given good to excellent leafspot control, but control of powdery mildew with these fungicides was not usually satisfactory. None of the remaining fungicides performed satisfactorily in the application schedules chosen.

Leafspot and powdery mildew are occasional limiting factors in tree size in the nursery under western New York conditions.

DEPARTMENT OF PLANT PATHOLOGY, NEW YORK STATE AGRICULTURAL EXPERIMENT STATION, GENEVA, NEW YORK

SOME HISTORICAL ASPECTS OF PEACH CANKER CAUSED BY THE FUNGUS FUSICOCCUM AMYGDALI DELACR.[1, 2]

Emil F. Guba

In 1898, Selby (7) reported a stem constriction disease of peach nursery stock in Ohio. In 1910, Selby (8) reported no further occurrences of the disease. The pathogen was designated Phoma persicae Sacc. No specimens are available for study. In 1912, Clinton (3) reported a canker encircling the nodes of twigs of young peach trees. Here, also, the fungus was ascribed to Phoma persicae Sacc. No specimens are available for study. In Delaware, in 1925, Adams (1) described leaf scar lesions caused by chemical sprays about the nodes of peach twigs. Some of the fungus Phoma persicae Sacc. was also found in nodal twig lesions, but it was not extensive.

In 1941, Haenseler and Daines (4) reported peach canker in New Jersey, and for the first time correctly identified the fungus found in association with the disease as Fusicoccum amygdali Delacr. The fungus was obtained in culture, and the disease was reproduced by spore inoculations of healthy peach twigs.

Roberts (5, 6) in 1940 and 1942 reported on the same disease, but his studies require considerable clarification. Specimens obtained in Delaware in 1938 were identified as the stem constriction disease, which was reported by Selby from Ohio in 1898 and which Selby attributed to the fungus Phoma persicae Sacc. Roberts alleged that Selby's illustration of the fungus, Pl. IX, fig. 3, was characteristic of the genus Phomopsis and that the Delaware peach canker or constriction disease was due to Phomopsis, although Stevenson who examined the material found no beta conidia. According to Roberts, the fungus produced both alpha and beta conidia in culture.

Roberts gave an unmistakably clear description and illustration of the Fusicoccum peach canker disease. He and Stevenson found no beta conidia in the cream-colored conidial tendrils issuing from the pycnidia in the cankers. Roberts asserted that they may be produced in pure culture. The disease from the beginning was confused with the stem constriction disease described by Selby in Ohio. Whatever that could have been no one now can know.

All of Roberts' isolates from peach with one exception yielded alpha and beta conidia and all resembled one another closely. These were determined to be cultures of Phomopsis. Thus, the isolates appeared to have no connection with the peach constriction disease that Roberts described and illustrated. On using these cultures for artificial inoculations, infections were successful only in induced burned areas about the buds of peach twigs. In moist chamber these twig infections produced pycnidia with alpha conidia. Uninjured inoculated nodes remained healthy. However, the ease of infecting uninjured nodes of peach twigs with water suspensions of conidia of Fusicoccum amygdali is recognized by studies in New Jersey and Massachusetts. Roberts identified his fungus as Phomopsis mali and alleged that the ascogenous stage was Diaporthe perniciosa March. or D. eres Nit. However, up to now no ascogenous stage of Fusicoccum amygdali has been reported.

Several specimens of the peach canker fungus were cited by Roberts, and most of them have been examined by the writer for identification, as follows:

1. Phoma persicae Sacc. Culture isolated from Prunus persica, State College, Pennsylvania, and submitted by C. R. Orton, Sept. 12, 1915. A. E. Jenkins recognized the misdetermination and identified the fungus as a Phomopsis, which study shows is correct. Jenkins added "This is evidently however the fungus described in Saccardo as Phoma persicae Sacc." This statement is not acceptable since the Saccardo specimen was not studied. Both alpha and beta spores are present in the Orton material.

2. Phoma persicae Sacc. on twigs of Prunus persica, Eastern Shore, Maryland, April 1938. Submitted by J. W. Roberts. The fungus here is definitely Fusicoccum amygdali Delacr. This is apparently the material submitted to Roberts by F. P. Cullinan in April 1938 and which led to Roberts' study of the disease.

3. Phoma persicae Sacc.?; Coniothecium or Dematium? also present. On twigs of Prunus persica, Kingston, Rhode Island. Collected by Frank Howard. The

---

[1] Contribution No. 1012, Mass. Agricultural Experiment Station.

[2] The writer is indebted to John A. Stevenson, Principal Mycologist in Charge, The National Fungus Collections, U. S. Department of Agriculture, for proof-reading the manuscript.

fungus here is definitely Fusicoccum amygdali Delacr. The collection by Howard bears no date.

4. Phoma persicae Sacc. On Prunus persica, Blacksburg, Virginia, January 1929, S. A. Wingard. The designation is correct. The Phoma spores in the specimens measure 5-7 x 3 μ. Every node in the specimens shows injury and chemical injury rather than infection is indicated as the primary factor. The Phoma is undoubtedly secondary. It agrees with the description of P. persicae Sacc. (Sacc. Syll. Fung. 3: 74-75. 1884).

5. Phoma persicae Sacc. On twigs of Prunus persica, Experiment, Georgia, Nov. 5, 1914, B. B. Higgins. Lesions on the twigs are very indefinite, and there are no symptoms suggestive of Fusicoccum canker. No fungus was found anywhere in the material.

It seems clear to the writer that Roberts failed to establish the identity of the pathogen of the peach constriction disease and, instead, employed an organism in his inoculation studies distinct from the one involved in the disease that he described and pictured. Studies have shown that Fusicoccum cankers sooner or later become invaded by a variety of secondary organisms. It is also evident that occurrence of the pathogen Fusicoccum amygdali on peach in the Atlantic Coastal Area, in the light of the literature and specimens, dates approximately from the year 1938. It was found in Massachusetts by Boyd (2) in 1940, but first came to the attention of our growers in 1938.

Literature Cited

1. Adams, J. R. 1925. The leaf scar lesions on peach trees. Trans. Penin. Hort. Soc. 14, No. 3 3 pp.
2. Boyd, O. C. 1941. Fusicoccum canker in peach in Massachusetts. Plant Dis. Reptr. 25: 273-274.
3. Clinton, G. P. 1913. Report of the Connecticut Agricultural Experiment Station. Part V, Rept. of the Botanist (1911-1912).
4. Haenseler, C. M., and R. H. Daines. 1941. Peach canker caused by Fusicoccum amygdali Delacr. (Abstract) Phytopath. 31: 10.
5. Roberts, J. W. 1940. The constriction disease of peach. Phytopath. 30: 963-968.
6. _____. 1942. The ascogenous stage of the peach constriction disease. Phytopath. 32: 335-336.
7. Selby, A. D. 1898. Constriction disease of stem and branch. In Preliminary report upon the diseases of the peach. Ohio Agr. Exp. Sta. Bul. 92: 233-234.
8. _____. 1910. Peach stem blight. In Brief handbook of the diseases of cultivated plants in Ohio. Ohio Agr. Exp. Sta. Bul. 214, 423-424, fig. 75.

WALTHAM FIELD STATION, DEPARTMENT OF BOTANY, UNIVERSITY OF MASSACHUSETTS, WALTHAM, MASSACHUSETTS

DISTRIBUTION OF CRINKLE LEAF OF COTTON IN ALABAMA AND ADJOINING STATES[1]

Albert L. Smith, O. N. Andrews, and J. I. Wear

Manganese toxicity, or crinkle leaf, was identified from cotton plant specimens submitted by the County Agent of Pickens County, Alabama, in 1954. Although this is the first published report of manganese toxicity in Alabama, an examination of color slides on file indicated that the disease was present in Lauderdale County in 1940. Other staff members of the A. P. I. Agronomy and Soils Department state that crinkle leaf symptoms have been observed in Limestone County. The known distribution of manganese toxicity in Alabama and the distribution reported in the literature (1, 2, 5) for other States is shown in Figure 1. The scattered distribution of the counties in the States involved suggests that the symptoms have only recently been recognized as such.

FIGURE 1. The distribution of crinkle leaf by counties in Arkansas, Louisiana, Mississippi and Alabama.

[1] Field Crops Research Branch, Agricultural Research Service, United States Department of Agriculture and Alabama Agricultural Experiment Station cooperating.

FIGURE 2. Right. Late season symptoms of crinkle leaf showing extreme stunting and shortened internodes. Left. Portion of small cotton plant with normal internode length and branching.

An examination of a Pickens County field showed a complete loss in yield of the 12-acre crop. The soil was classified as a Prentiss very fine sandy loam, with a pH range from 4.4 to 4.8. In the Limestone County area, the Decatur clay loam had a pH of 4.4. A test showed a very high concentration of water-soluble manganese. Changing the pH of this soil to 6.9 with lime reduced the water soluble manganese to 1.0 percent of the original concentration. Of the three locations in Alabama, two were in the Tennessee Valley and one in the Upper Coastal Plain.

The early-season symptoms of crinkle leaf were described and illustrated by Neal (2). He pointed out the close similarity of this disease to thrip injury, which occurs commonly in many fields early in the growing season. Neal further stated that there was no abortion of the terminal bud as often occurs in cotton plants attacked by thrips. The late season symptoms of manganese toxicity, as shown in Figure 2, were not characteristic of any other disease in the experience of the writers. The continued terminal growth, shortened internodes, multiple-bud formation, and stunting assist in differentiating crinkle leaf symptoms from those caused by thrips.

Previous workers (1, 2, 3, 5) reported that crinkle leaf is associated with high acidity, cal-

cium deficiency, manganese toxicity, low organic matter, and sometimes poor drainage. Young and Beacher (4) stated that compaction and poor drainage may cause toxic concentrations of soluble manganese in limed soils with a pH of 6.8. In most cases studied by these workers, symptoms of crinkle leaf occurred in soil with pH ranges from 4.2 to 5.4 and the addition of limestone gave satisfactory control. Rogers (4) recently pointed out that only 210,000 tons of lime were applied to Alabama soils in 1953, although the estimated annual need was 1,056,000 tons. The use of higher analysis acid-forming fertilizers and nitrogenous materials accentuates the importance of lime application to maintain proper pH level. A minimum pH of 5.5 is recommended for cotton production in Alabama.

Literature Cited

1. Lancaster, J. D., and L. E. Gholston. 1953. Crinkle leaf of cotton corrected by use of lime. Mississippi Farm Research, (State College, Mississippi) Volume 16, page 7, December.
2. Neal, D. C. 1937. Crinkle leaf, a new disease of cotton in Louisiana. Phytopath 27: 1171-1175.
3. _____, and H. C. Lovett. 1938. Further studies of crinkle leaf, a disorder of cotton plants prevalent in Lintonia and Olivier silt loam soils of Louisiana. Phytopath. 28: 582-587.
4. Rogers, H. T. 1955. Farm Forum. (New York) July.
5. Young, V. H., and R. L. Beacher. 1952. Crinkle leaf of cotton, a result of manganese toxicity. Arkansas Farm Research. Volume 1, Number 2.

DEPARTMENT OF AGRONOMY AND SOILS, A.P.I., AGRICULTURAL EXPERIMENT STATION, AUBURN, ALABAMA

REACTION OF KENAF INTRODUCTIONS AND SELECTIONS TO RACES OF COLLETOTRICHUM HIBISCI

James B. Pate and Thomas E. Summers

Summary

In July and October of 1954, kenaf breeding materials were tested for reaction to races 1 and 2 of Colletotrichum hibisci. Javanese, Manchurian, and Peruvian varieties were susceptible to both races. Some plants in the Salvadorian variety were resistant to each of the races.

Certain Salvadorian lines were susceptible to both races; others were resistant to race 1 and susceptible to race 2; while still others were resistant to both races in the summer, but gave an intermediate reaction to a mixture of races in the fall. Lower temperatures following inoculation apparently account for the more susceptible reaction in the fall.

An F_4 Salvadorian x Javanese line and two first generation selfed lines from an Egyptian introduction were found to possess the highest degree of resistance after the fall inoculations.

The severity and importance of the disease of kenaf caused by Colletotrichum hibisci Poll. has been reported (1, 3). Selection for resistance to this fungus has been one of the primary objectives of the kenaf breeding program in Florida. In 1952, various varieties available at that time were tested for resistance. Plants of the Salvadorian variety ranged from highly resistant to completely susceptible. All other varieties were found to be susceptible, though the degree of susceptibility varied.

Selection within the Salvadorian variety was initiated, and a report on the apparent resistance of first generation selfed lines was made in 1953 (2). These lines remained highly resistant during the second generation of selection, but in the third generation the disease developed in certain of these lines late in the season, though these lines had been highly resistant following earlier artificial inoculations. The existence of three physiologic races of the fungus explained the sudden breakdown of these lines (4). Since only one of these races had been used in selecting for resistance, it was necessary to test all breeding materials for reaction to the other races. This paper is concerned with the results of these tests and the progress made to date in breeding for resistance to the known races of C. hibisci.

Materials and Methods

Since races 1 and 3 are very similar (4), inoculum of the two was combined for these experiments, and will be referred to as race 1 in this paper. The same varieties tested in 1952 and all lines selected at this station were planted in the summer of 1954. Approximately one-half of the plants of each variety were inoculated with race 1 and the other half with race 2. For testing the lines, two rows of each selfed progeny were planted, and separate inoculations with races 1 and 2 were made. The regular fall 1954 breeding nursery was made up of lines tested during the summer. Single rows of each selfed progeny were planted and inoculated with a mixture of races 1 and 2. Inoculations and reaction readings in all plantings were made as described previously (4).

Results and Discussion

The reaction of five varieties of kenaf to races 1 and 2 is given in Table 1. Varieties A, D, E, and I were highly susceptible to both races, while variety J (Salvadorian) showed some resistance to both races. These results point out the importance of the Salvadorian variety in the selection program for resistance to C. hibisci and the need for continued testing of kenaf introductions for additional sources of resistance.

The reaction of representative lines of kenaf following inoculation is given in Table 2. A group of lines represented in the Table by BG-51-3 was found to be completely susceptible to both races. Many lines that were highly resistant to race 1, such as BG-51-1, were found to be completely susceptible to race 2. Several lines such as BG-52-7 and BG-52-41 were found to possess good resistance to both races following inoculation in the summer. However, these same lines were intermediate in reaction after inoculation in the fall nursery.

It has been shown that certain lines of kenaf give a more susceptible reaction to race 2 when inoculated at low temperatures (5). Minimum temperatures for five nights following the inocu-

Table 1. Reaction of kenaf varieties following inoculation in July of 1954 with races 1 and 2 of C. hibisci.

Variety	Source	PI Number	Race of C. hibisci	Number of Plants HR	R	I	S	CS
A	Java	207894	1	0	0	0	58	120
			2	0	0	2	40	130
D	Manchuria	207896	1	0	0	0	0	89
			2	0	0	0	0	73
E	Java	207897	1	0	0	0	69	271
			2	0	0	1	78	219
I	Peru	207901	1	0	0	6	6	101
			2	0	0	0	0	112
J	El Salvador	207883	1	12	4	21	21	72
			2	1	10	13	20	90

Table 2. Reaction of representative lines of kenaf following inoculation with races 1 and 2 of C. hibisci.

Parentage and Line	Inoculation Date - 1954	Number of Progenies	Race of C. hibisci	Number of Plants HR	R	I	S	CS
Variety J:								
BG-51-3	July	2	1	0	0	0	0	10
	July	2	2	0	0	0	0	10
	October	3	1 + 2	0	0	0	0	38
BG-51-1	July	12	1	103	37	0	0	0
	July	12	2	0	0	5	48	100
	October	2	1 + 2	0	0	0	0	10
BG-52-7	July	8	1	62	11	15	0	0
	July	8	2	45	24	15	0	0
	October	4	1 + 2	0	0	99	26	0
BG-52-41	July	4	1	26	0	0	0	0
	July	4	2	18	7	4	0	0
	October	5	1 + 2	0	0	113	26	0
Variety J x Variety A F_4:								
BG-52-110	October	2	1 + 2	0	27	0	0	0
Egyptian PI 209230:								
BG-53-84	October	1	1 + 2	0	7	0	0	0
BG-53-88	October	1	1 + 2	0	31	0	0	0

lations in July ranged from 24° to 25° C, while following inoculations in late October, the range was from 15° to 19°. It seems very probable that the lower temperatures account for the more susceptible reaction of certain lines in the fall nursery. It is also probable that the resistance to race 2 found in the Salvadorian variety after inoculation in the summer (Table 1) can be attributed to a temperature effect. These effects of temperature in certain lines show that critical testing for reaction to C. hibisci must be done during the fall or winter months.

These results show that there are several Salvadorian lines available that might be expected to give good resistance to C. hibisci during the summer months when kenaf is grown for fiber. These lines have been grown during the summer for fiber in yield trials, and no appreciable damage due to C. hibisci occurred. Since the reproductive phase in kenaf is initiated by short day lengths, seed must be produced during the fall or winter months when temperature may be favorable for disease development. However, in the fall nursery seed capsules of intermediate lines were not seriously affected by the disease. It thus appears that seed production in such lines would not be appreciably affected by the disease.

As shown in Table 2, the highest degree of resistance in the fall nursery was found in an F_4 line derived from a cross of Salvadorian and Javanese varieties and in two first generation selfed lines out of an Egyptian introduction, PI 209230. All plants of these three lines were classified resistant. This indicates that lines of greater resistance than the intermediate Salvadorian lines are a possibility, and that all introductions should be thoroughly tested during the fall to determine if the recovery of more resistant types is possible. Continued introduction and testing is desirable to determine additional sources of resistance.

Literature Cited

1. Crandall, B. S., J. L. Parrado, and R. Roque. 1953. Las enfermedades del kenaf y su control. Ministerio de Agricultura de Cuba. Commission Cooperativa de Fibras. Circular Agricola No. 4.
2. Pate, J. B. 1953. Resistance in kenaf to Colletotrichum hibisci. Phytopath. 43: 647-648.
3. Presley, J. T. 1952. Tip blight of kenaf: A brief history of the disease. Plant Dis. Reptr. 36: 333.
4. Summers, T. E. 1954. Physiologic specialization of Colletotrichum hibisci Poll. on kenaf. Plant Dis. Reptr. 38: 483-486.
5. _____, and J. B. Pate. 1955. Influence of temperature on the susceptibility of kenaf to Colletotrichum hibisci Poll. Plant Dis. Reptr. 39: 650-651.

FIELD CROPS RESEARCH BRANCH, AGRICULTURAL RESEARCH SERVICE, UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH EVERGLADES EXPERIMENT STATION, BELLE GLADE, FLORIDA

CALLA RHIZOME TREATMENTS

Louise T. Dosdall

During the past several years many florists in Minnesota have had severe losses with their callas, especially when the plants were grown in beds. In all plantings examined the losses were due to either Phytophthora root rot [P. cryptogea var. richardiae] or to bacterial soft rot [Erwinia spp.]. Sometimes both diseases were present in the same planting. Two greenhouse operators made available their diseased plantings for determining the effectiveness of various rhizome treatments on the control of these diseases.

In the first greenhouse a ground bed of callas approximately 10 by 75 feet had to be abandoned because of bacterial soft rot in the rhizomes. These rhizomes were dug late in October 1953 and dried. Late in November they were cleaned, treated as indicated in Table 1 and replanted.

Table 1. The effect of four calla rhizome treatments on the control of bacterial soft rot[a].

Treatment		Number of plants alive			Percentage plants alive
Material	Rate	Jan. 16	Feb. 21	March 23	March 23
Mercuric chloride	1:1000 1 hour soak	15	15	15	88
Peracetic Acid[b]	1 percent 5 minute dip	15	14	14	82
Ceresan M	1 pound/50 gal. 1 hour soak	17	11	6	35
Actidione	5 ppm 1 hour soak	1	0	0	0
Check	Dry rhizomes planted	16	13	10	58

a Rhizomes dug October, 1953. Rhizomes treated and planted November 20, 1953.
b PAC Niagara.

Only 85 rhizomes of miscellaneous size and condition were salvaged. These were divided into 5 lots of 17 rhizomes each. An attempt was made to distribute the rhizomes in the 5 lots impartially, but it is possible that there may have been a tendency for the best rhizomes to fall into one lot and the poorest into another. The method of distribution was as follows: the 5 largest rhizomes (about 2 inches) were selected and each formed the nucleus of one lot, then the next 5 largest rhizomes were distributed, 1 to each lot, and so on until the entire number was allocated. The smallest rhizomes were about 1/2 inch in diameter. Immediately after treatment, the rhizomes were planted, a single rhizome to a pot. Both pots and soil had been disinfected previously with steam.

The results of this series of treatments are given in Table 1. Since the size of the plants varied so much in each lot, and disease symptoms could not be evaluated quantitatively, the effect of the treatments was judged by the number of plants remaining on the dates of observation.

In the second greenhouse the callas were grown in a raised bench 5 feet wide by 50 feet long. This bed had been examined from time to time and was found to contain a great deal of Phytophthora root rot with the resulting browning of the leaf margins and leaf spotting. There was some bacterial rot in the rhizomes. The bed had not been producing flowers enough to justify its maintenance.

These rhizomes were dug early in January 1954, and dried until early July. The rhizomes

Table 2. Effect of calla rhizome treatments on the control of Phytophthora root rot[a].

Treatment		Number of plants				Percent
Material	Rate	Total[b]	Condition[c]			Good plants
			Good	Medium	Poor	
Peracetic acid	1 percent 5 minute dip	31	25	5	1	71
Formaldehyde	2 percent 1 hour soak	27	16	4	7	46
Spergon	2 oz./gal. 3 hour soak	26	14	6	6	40
Captan	2 oz./gal. 1 hour soak	24	7	10	7	20
Mercuric chloride	1:1000 1 hour soak	20	4	7	9	11
Ceresan M	1:400 1 hour soak	21	1	4	16	3
Check -wet	water 1 hour soak	21	8	4	9	23
Check -dry	no treatment	20	7	5	8	20

[a] Rhizomes treated and planted July 8, 1954. Observations: March 30, 1955.

[b] 35 rhizomes planted in each lot.

[c] Good= sturdy plant with green foliage and no marginal yellowing.
Medium= sturdy plant but with some marginal yellowing and spotting of the leaves.
Poor= plant stunted, outer leaves often dry, others badly spotted at the margins, young leaves badly twisted and curled when emerging.

were then washed and cleaned of all dead roots and leaves. They were divided into 8 lots, each lot containing 15 large rhizomes (1 1/2 inch to 1/2 inch) and 20 small rhizomes (1/2 inch or less). After being treated as indicated in Table 2, they were planted immediately, each rhizome in its own pot of steamed soil. The results are indicated in Table 2.

In the second series of treatments there was no evidence of bacterial soft rot when the final observations were made. About a month previously the grower had removed the pots in which the plants were missing or in poor condition. Because of variability in the size of the rhizomes and resulting plants, no attempt was made to keep a record of the number of flowers harvested from the different lots.

In both series of treatments peracetic acid proved to be a promising calla rhizome disinfectant and seemingly is deserving of further tests. The plants from peracetic acid-treated rhizomes were so superior in general vigor and appearance that they could be picked out with a glance in both series. The drawbacks to its general use at present are the instability of the material and the hazards connected with its use. Noteworthy is the fact that mercuric chloride gave practically as good results as the peracetic acid in one series of treatments and in the other series was not satisfactory at all. This particular grower had been using the recommended mercuric chloride treatment on his calla rhizomes plus steam disinfection of the soil for a number of years but without success in controlling disease.

DEPARTMENT OF PLANT PATHOLOGY AND BOTANY, INSTITUTE OF AGRICULTURE
UNIVERSITY OF MINNESOTA, ST. PAUL 1, MINNESOTA

EUROPEAN RHODODENDRON RUST (CHRYSOMYXA LEDI VAR. RHODODENDRI) IN THE UNITED STATES

Charles J. Gould, Maksis Eglitis, and Charles C. Doughty[1]

Summary

Chrysomyxa ledi (Alb. & Schw.) de Bary var. rhododendri (DC.) Savile, has been collected on rhododendrons in a commercial nursery in western Washington. This is apparently the first record of its appearance in the United States. The rust is believed to have been introduced from Europe on imported plants.

Chrysomyxa ledi (Alb. & Schw.) de Bary var. rhododendri (DC.) Savile has been common in Europe and Asia for many years, and has occasionally been found in Canada. It has now reached the United States.

On May 3, 1954, we collected rust-infected leaves on several varieties of rhododendrons in a large commercial nursery in western Washington. Samples were submitted to Dr. George W. Fischer who identified the rust as Chrysomyxa rhododendri (DC.) de Bary (C. ledi var. rhododendri). Drs. George B. Cummins and D. B. O. Savile confirmed the identification. According to Edith K. Cash, of the National Fungus Collections, Agricultural Research Service, U. S. Department of Agriculture (2) there had been no previous record of this rust in the United States. D. B. O. Savile also stated (4) that this is the first collection on cultivated rhododendrons in North America. The only other collections have been made on the wild Rhododendron lapponicum in northern British Columbia, District of Mackenzie, Manitoba, and Newfoundland (3 and 4).

Since the distance is so great from northern British Columbia to the affected nursery in Washington, and the intervening rhododendrons in British Columbia are unaffected (5), it appears that the rust must have entered the United States on imported nursery stock. This has happened despite the fact that importations of known susceptible types of rhododendrons have been subject to Federal post-entry quarantine. The affected nursery is known to have imported rhododendrons directly from England and Canada and azaleas from Holland, and also to have purchased recently imported plants from other nurseries. Infections that occur in late summer may overwinter as mycelium in the evergreen leaves of rhododendrons and could easily escape the most rigorous quarantine inspection.

Several varieties were found infected at the time of the original observation, and additional ones have been found infected since then. There is apparently a great variation in susceptibility. Three of the most susceptible varieties appear to be Exoniense, Bibiani, and Broughtonii aureum, according to our observations and, in addition, Ivery's Scarlet, Sappho, and Rosamund Millais, according to observations by the former nursery manager.

Abundant yellow uredia were observed at the time of the original collection in May and at subsequent intervals throughout the summer and fall of 1954. The rust spread to many varieties during the summer, but by November it appeared to be declining in intensity. On June 2, 1955, the rust was again common on certain varieties and appeared to be spreading, according to the manager, but on July 22, we were able to find only a few leaves bearing new uredial sori.

This rust is known primarily as an alpine rust in Europe. Therefore its severe attack at sea level in western Washington is puzzling. In addition, the latter region has been relatively free from serious rust attacks on ornamentals, with the exception of hollyhocks. Perhaps the unusually warm fall of 1953 and wet summer of 1954 were contributing factors. In any event, the rust is probably here to stay, along with Chrysomyxa piperiana (Arth.) Sacc. & Trott. (6) which has been relatively unimportant.

Most rhododendrons are sold and shipped from the nursery during the winter and early spring months. Therefore, by the time the rust had been found and identified, several thousand plants had already left the nursery through wholesale and retail outlets. Although plants obviously infected with rust were apparently not sold, it would be expected that some infected plants not exhibiting sori would have been shipped. This suspicion has been supported by reports of subsequent development of a rust on some of these plants. Consequently, other pathologists are urged to be on the lookout for it. Control studies are under way.

---

[1] Plant Pathologist and Research Associate of the Western Washington Experiment Station, and Superintendent of the Cranberry-Blueberry Experiment Station, Washington Agricultural Experiment Stations, State College of Washington.

References and Notes Cited

2. Cash, Edith K. July 7, 1954. Personal communication.
3. Savile, D. B. O. 1950. North American Species of Chrysomyxa. Canad. Jour. Res. 28: 318-330.
4. _____. June 7, 1954. Personal communication.
5. _____. September 28, 1954. Personal communication.
6. Weiss, Freeman. 1950. Index of Plant Diseases in the United States, Part II, p. 320. Plant Dis. Survey, Spec. Publ. No. 1.

WESTERN WASHINGTON EXPERIMENT STATION, STATE COLLEGE OF WASHINGTON, PUYALLUP, WASHINGTON

PROGRESS OF OAK WILT IN WEST VIRGINIA[1]

William H. Gillespie and R. P. True[2]

The first intensive state-wide survey for oak wilt (Endoconidiophora fagacearum) in West Virginia, made possible by a special appropriation of the 1954 Legislature, was begun June 6, 1955. The survey is under the direction of the West Virginia Department of Agriculture with the State Conservation Commission, the Federal Forest Service, and West Virginia University co-operating. The first half of the aerial survey has located more than 600 suspected infection spots; however, only about 50 percent of these have been ground checked. As of August 1, a total of 300 new oak wilt locations has been visited and confirmed by the ground personnel[3]. Four of these newly found infection spots constitute the first known oak wilt locations in Marion, Harrison, Fayette, and Calhoun Counties. In a partial survey of the State in 1954, a total of only 145 individual oak wilt trees was found.

The diseased trees found so far in 1955 have been processed by use of the dry girdle method[4]. The stumps below the girdle have been peeled as an additional precaution.

The greater number of oak wilt trees and the pattern of spread found this year suggests that the disease presents a more immediate threat to some portions of the State than was previously thought. Most of the new infections are grouped within and around a few centers. The largest of these encompasses all of Boone and Logan as well as adjacent parts of the adjoining Counties. Another heavily infested area in the Northeastern part of the State includes the North Fork Valley in Pendleton and Grant Counties and the lower slopes of Knobly Mountain in Mineral County.

Table 1. Comparative rate of incidence of multiple tree oak wilt infection spots in Northeastern and Southern counties of West Virginia (based on data available August 1).

Oak wilt centers	Counties	Number of trees with current symptoms at each site			Percentage of sites with old dead trees[a]
		1	2	More than 2	
Northeastern disease-center	Mineral	20	11	16	79
	Hampshire	16	2	1	66
	Grant	7	3	1	57
	Total	43	16	18	
	Percent	(56)	(21)	(23)	
Southern disease center	Kanawha	27	0	0	4
	Boone	24	2	0	25
	Logan	20	2	0	43
	Total	71	4	0	
	Percent	(95)	(5)	(0)	

[a] In the southern counties, oak wilt-killed trees found and removed in previous years make up the bulk of the "dead trees" upon which percentage figures in this column are based.

[1] Published with the approval of the Director of the West Virginia Agricultural Experiment Station, as Science Paper No. 512.

[2] Coordinator, West Virginia Oak Wilt Survey, and Plant Pathologist, Agricultural Experiment Station, West Virginia University.

[3] Most of the oak wilt trees are this year being diagnosed in the field by experienced men. Samples are sent in from suspect trees in counties where oak wilt has not been found before, and every fifth tree found by each ground crew is sampled and cultured in the laboratory.

[4] True, Craig, and Cuppett. Current Report 8, West Virginia University Experiment Station, February 1955.

In some northeastern counties the underground spread through natural root grafts has proved to be more frequent and to have caused greater loss at individual sites than has been previously observed or is now found in other parts of the State. This local intensification is appearing in areas where oak wilt seems to have been present for a comparatively short time. From one to 20 actively wilting trees are found at infection spots in some northeastern counties whereas usually only one or sometimes two trees are found at new disease locations in the rest of the State. More dead trees are found within root graft distance of new symptom trees in these areas.

Work is now in progress to determine specific factors responsible for the intensified localized spread within infection areas recently found in some northeastern counties.

The important information obtained so far in this first intensive state-wide survey in West Virginia points out the limitations of the type of localized survey and control procedures employed by necessity in earlier years. It demonstrates the value of undertaking and the need for continuing survey and control work on a state-wide basis.

WEST VIRGINIA OAK WILT SURVEY AND WEST VIRGINIA AGRICULTURAL EXPERIMENT STATION

PRELIMINARY LIST OF NOTEWORTHY DISEASES OF CULTIVATED PLANTS IN CONTINENTAL EASTERN CHINA

R. Ciferri

Summary

A list of the commonest or most serious or otherwise noteworthy diseases of cultivated plants in continental China is presented, with a few remarks obtained directly from local sources.

Only diseases due to cryptogamic pathogens and viruses are considered, except for a few observations on deficiency diseases.

During a trip through eastern China lasting for about a month and a half in the autumn of 1954, the writer observed a number of diseases, mostly parasitic, of cultivated plants. The list that follows includes only plant diseases of practical importance, or diseases that have been recently identified or are still under study. No attempt has been made to compile a complete list of plant diseases in eastern Continental China.

The regions visited included the eastern provinces of South, Central, and North China (Kwangtung, Hunan, Kiangsi, Fukien, Hupeh, Anhwei, Kiangsu, Honan, Shantung, Hopeh, Liaotung, and Gili).

Many data were obtained from direct observation in fields and markets, but much more came from pathological collections and herbaria, and from records of Plant Pathology Institutes, Laboratories of Agricultural Faculties, and Experiment Stations. I am indebted to the courtesy of phytopathologists, botanists, and crop specialists of the University and Experimental Stations of Kwangchow, Wu-Han, Shanghai, Nanking, Peiping, and Shenyang (Mukden), as well as to many students of the Academy of Sciences of Peiping (Peking), and chiefly to Professor F. L. TAI, author of the mycological survey of China (4).

Besides TAI's mycological survey already mentioned (4), LING's host index for Szechwan (2), and SIANG's list of non-fungous plant diseases (3) are valuable contributions to phytopathological knowledge in China. To these papers must be added DARKER's list covering East Asia.

In conclusion, a great deal more work on plant diseases in China is needed, especially on nonparasitic and virus diseases. To this end a number of Chinese students of phytopathology are making regular surveys. It is hoped that in the near future much more adequate information will become available.

In the following list, host plants are arranged alphabetically. For the sake of brevity only the Latin names of cryptogamic pathogens are given.

ALFALFA: Peronospora trifoliorum De By (here listed as P. aestivalis Syd.); Pyrenopeziza medicaginis Fuckel; Uromyces striatus Schroet. (?var. medicaginis (Pass.) Arth.); Septoria spp., including S. medicaginis Rob. & Desm., and other leaf fungi; Rhizoctonia spp., including R. crocorum DC. (under R. violacea Tul.).

Rare: an unidentified mosaic. Very common: phosphorus and potash deficiencies, alone or associated.

APPLE: The most serious diseases, chiefly in Central and Northeastern China, are the stem canker caused by Valsa mali Miyabe & Yamada (the Cytospora imperfect stage is usually present), together with Sclerotinia kaijana (?Author; it is not clear whether this species is the same as S. mali Takah. previously found also in China). Venturia inaequalis (Cke.) Winter and Podosphaera sp., here indicated as P. leucotricha (Ell. & Ev.) Salm., are very frequent but, as a rule, not very serious. Other pathogens are: Agrobacterium tumefaciens (E. F. Sm. & Towns.) Conn; Diaporthe pomigena (Schroet.) Miura causing an irregularly diffused canker; Glomerella cingulata (Ston.) Spauld. & Schrenk; Gymnosporangium yamadai Miyabe; Marssonina mali (P. Henn.) Ito; Macrophoma kuwatsukai Hara.

A fly speck, bitter pit, and Jonathan spot of fruits are present. Phosphorus and potash deficiencies are of very common occurrence.

Chemical protection of apple trees is generally very inadequate.

BEAN (Phaseolus): Xanthomonas phaseoli (E. F. Sm.) Dowson; Glomerella lindemuthiana (Sacc. & Magn.) Shear; the rust Uromyces appendiculatus (Pers.) Link; several leaf spot fungi.

The bean mosaic virus (Phaseolus virus 1) is of common occurrence; rarer is the yellow mosaic (Phaseolus virus 2).

BEET: Cercospora beticola Sacc., very frequent; Corticium and/or Hypochnus spp.; one or several bacterial diseases including Pseudomonas aptata (Brown & Jamieson) F. L. Stev.; heart rot (?Phoma betae Frank).

BROAD BEAN (Vicia): Uromyces fabae (Pers.) De By.; Botrytis cinerea Pers., probably together with B. fabae Rodr. Sard. (from the appearance of the spots); Cercospora zonata Winter. A doubtful disease caused by Phytomonas viciae (Yü) Berkh. (to be compared with Bacterium viciae Myeda from Japan).

A virus disease caused by the yellow bean mosaic virus (Phaseolus virus 2 or Pea mosaic virus 2) has been found, together with spotted wilt (Lycopersicon virus 3) and mosaic with enation (Pisum virus 1).

CABBAGE AND ALLIED SPECIES: Erwinia carotovora (L. R. Jones) Holland; Xanthomonas campestris (Pam.) Dowson (and Pseudomonas maculicola (McCul.) F. L. Stev., not seen); Plasmodiophora brassicae Wor., exceedingly common (in Canton only also a rare, tubercle-forming species morphologically similar to Thecaphora, yet undescribed); Albugo candida (Pers.) Kuntze; Peronospora parasitica (Pers.) ex Fr.; Phoma lingam (Tode) Desm.; Cercosporella brassicae (Fautr. & Roum.) Hoehn. including C. albomaculans (Ell. & Ev.) Sacc.; Botrytis cinerea Pers.; Alternaria brassicae (Berk.) Sacc. including A. herculea (Ell. & Mart.) J. A. Elliott.

A mosaic disease caused by Brassica virus 4 (? Turnip virus 1) is present, together with a few other viruses.

CELERY: Septoria apii-graveolentis Dorogin. The bacterial leaf spot attributed to Pseudomonas apii Jacq. has been found (localized), together with soft rots.

Yellows caused by Callistephus virus 1A has been found, together with an unidentified mosaic virus.

CEREALS (other than corn, rice, and wheat). On barley: Erysiphe graminis DC., Fusarium spp., Helminthosporium spp. chiefly of the type H. gramineum Rabh.; Puccinia glumarum (Schm.) Erikss. & P. Henn., P. graminis Pers., and P. rubigo-vera (DC.) Wint.; Ustilago hordei (Pers.) Lagh.; U. nuda (Jens.) Rostr.

On oats: Erysiphe graminis DC.; Fusarium spp.; Puccinia coronata Cda., P. graminis Pers., P. rubigo-vera (DC.) Wint.; Ustilago avenae (Pers.) Rostr.; U. kolleri Wille (as U. levis Kell. & Sw.) Magnus) on Avena spp.

Xanthomonas translucens (L. R. Jones, A. G. Johnson, & Reddy) Dowson, on barley.

CHESTNUT: The indigenous species Castanea mollissima Bl., C. henryi Rehd. & Wils. and C. sequinii Dode are resistant both to Phytophthora cambivora (Petri) Buism. and Endothia parasitica Anders. (the last is apparently, an uncommon or localized species)[1].

CITRUS: The most important disease is caused by Xanthomonas citri (Hasse) Dowson, but frequent are Phytophthora spp., probably both P. citrophthora (R. E. & E. H. Sm.) Leon. and P. parasitica Dast., and Diaporthe citri Wolf; Diplodia natalensis Evans; Elsinoë fawcettii Bit. & Jenk.; Glomerella cingulata (Ston.) Spauld & Schrenk (under the imperfect stage of Colletotrichum gloeosporioides Penz.); blue and green molds. (Penicillium spp.)

Zinc and manganese deficiencies are very frequent.

A disease which is probably of virus nature has been observed in Kwangtung Province. It appears to be a serious disease, allied to but distinct from "quick-decline", now under study by Chinese specialists. Psorosis, foliocellosis, yellowing, etc. are found.

Loranthaceous parasites are not rare.

CLOVERS: Sclerotinia trifoliorum Eriksss.; Uromyces spp.; Cercospora zebrina Pass. A mosaic disease is scattered widely. For deficiency diseases see under Alfalfa.

CONIFERS: Several species of Gymnosporangium on Juniperus spp.; Milesina vogesiaca P. & H. Syd. on Abies spp.; several species of Fomes, Trametes, Polyporus, and Stereum on Pinus spp.; the Loranthaceous Arceuthobium chinense Lecomte and other species rather common on several host plants.

CORN: The presence of Bacterium stewarti E. F. Sm. is discussed; Fusarium spp.; Physoderma maydis Miyabe (under P. zeae-maydis Shaw); Cochliobolus heterostrophus Drechs. (in the conidial stage Helminthosporium maydis Nisik. & Miyabe); H. turcicum Pass.; Nigrospora spp.; Ustilago maydis (DC.) Cda.

Streak (Zea virus 2) and stripe (Zea virus 1) are localized and unimportant.

Nitrogen and phosphorus deficiencies are frequent.

COTTON: Apparently the most serious disease is caused by Glomerella gossypii Edg.; Verticillium albo-atrum Reinke & Berth.; Rhizoctonia solani Kuehn; boll rots caused by several unidentified fungi, including Fusarium spp.; Fusarium vasinfectum Atk. is quite frequent, as well as spots, blight, and rots caused by Xanthomonas malvacearum (E. F. Sm.) Dowson.

Nonparasitic "rust" caused by potash deficiency is frequent, also phosphorus and nitrogen deficiencies.

CUCURBITACEOUS PLANTS: Mycosphaerella citrullina (C. O. Sm.) Gross., Erwinia tracheiphila (E. F. Sm.) Holland, ?Pseudomonas lacrymans (E. F. Sm. & Bryan) Carsner, and Sphaerotheca fuliginea (Schlecht.) Poll. are common, chiefly on cucumbers; Colletotrichum lagenarium (Pass.) Ell. & Halst. chiefly on squashes, together with Fusarium niveum E. F. Sm., of general occurrence; Cladosporium cucumerinum Ell. & Halst., Peronoplasmopara cubensis (Berk. & Curt.) Clint. (Pseudoperonospora cubensis (Berk. & Curt.) Rostow.) and Phytophthora spp. (on fruits); Pythium spp. (including P. aphanidermatum (Edson) Fitzp.).

Cucumber mosaic virus (Cucumis virus 1) is present, chiefly on cucumber.

DOLICHOS BEANS: Ascochyta spp., probably both A. lathyri Trail. and A. pisi Lib.; Botrytis cinerea Pers.

The yellow bean mosaic caused by Phaseolus virus 2 is found.

EGGPLANT: Phomopsis vexans (Sacc. & Syd.) Harter; Phytophthora parasitica Dast.; Verticillium albo-atrum Reinke & Berth., including several allied species; Xanthomonas solanacearum (E. F. Sm.) Dowson.

Mosaic (Nicotiana virus 1) and one or two other virus diseases were found.

FLAX: Colletotrichum lini (West.) Toch. (usually under the binomial C. linicolum Peth. & Laff.); Fusarium lini Bolley.

---

[1]The specimen observed was the imperfect stage (Endothiella).

FRUIT TREES (GENERAL): Armillariella mellea (Vahl ex Fr.) Karst.; Helicobasidium mompa Tanaka; Rosellinia necatrix (Hart.) Berlese (conventional).

Several nutritional deficiencies are of common occurrence, chiefly potash and phosphorus deficiencies.

GRAPE: Coniella diplodiella (Speg.) Petr. & Syd. (usually under the binomial Coniothyrium diplodiella (Speg.) Sacc.); Botrytis cinerea Pers. ex Fr.; Glomerella cingulata (Ston.) Spauld. & Schrenk; Guignardia bidwellii (Ell.) Viala & Ravaz; Mycosphaerella personata Higgins (under the binomial Isariopsis clavispora (Berk. & Curt.)Sacc.); Elsinoë ampelina (De By.) Shear; Macrophoma sp. on ary berries; Plasmopara viticola (Berk. & Curt.) Berl. & De Toni.

Agrobacterium tumefaciens (E. F. Sm. & Towns.) Conn is uncommon.

Potash, phosphorus, and magnesium deficiencies were observed.

HIBISCUS (several species): Colletotrichum hibisci Poll. (only a strain of C. gloeosporioides Penz.); Fusarium vasinfectum Atk.

JUTE: One leaf spot caused by Cercospora sp. and a stem rot caused by an unidentified fungus are present.

A diffused but not serious disease is the bacterial leaf spot caused by Xanthomonas nakatae (Okabe) Dowson.

KAOLIANG (Sorghum spp.): Several, not well distinguished species of smut fungi. Bacterial spot (Pseudomonas syringae van Hall) and bacterial stripe (P. andropogoni (E. F. Sm.) Stapp) are found, the latter more widespread.

A stripe disease (Zea virus 1) is described.

LETTUCE: Both bacterial diseases are indicated: Pseudomonas marginalis (N. A. Brown) F. L. Stev. and Xanthomonas vitians (N. A. Brown) Starr & Weiss, at least one of which corresponds to Bacterium lactucae Yamamato (from Japan).

A mosaic disease appears to be of common occurrence.

LOQUAT: Pseudomonas eriobotryae (Tak.) Dowson is known but was not observed (localized).

MALANGA AND TARO: Erwinia carotovora (L. R. Jones) Holland (including E. aroideae (Towns.) Holland); Phytophthora colocasiae Rac. Bacterium colocasiae Takimoto, causing a leaf spot in Sikiang, is a doubtful species.

MILLETS: Sclerospora graminicola (Sacc.) Schroet., of common occurrence in moist places, also on other grasses; Claviceps purpurea Tul.; Helminthosporium sp. (on Setaria); Ustilago crameri Koern. (id.); Tilletia sp. (id.); Uromyces setariae-italicae (Diet.) Yosh.

MULBERRY: Mycosphaerella sp. (M. mori (Fuck.) Lind. ?) in the conidial stages; Phyllactinia corylea Pers. ex Karst.; Sclerotinia sclerotiorum (Lib.) De By. or allied species; Uncinula mori Miyabe; Nectria spp.; also Pseudomonas mori (Boy. & Lamb.) F. L. Stev,, are of common occurrence.

Several diseases are not yet fully understood, chiefly a diaporthaceous canker, Helicobasidium spp., and several Polyporaceous fungi.

ONION (and several other species of the genus Allium): Alternaria sp., probably A. porri (Ell.) Cif.; Botrytis spp.; Colletotrichum circinans (Berk.) Vogl.; Peronospora schleideni Unger (also under P. schleideniana De By.); Puccinia allii (DC) Rud. (and P. porri (Sow.) Wint.); Tuburcinia cepulae (Frost) Liro. Bulb rot appears to be quite frequent; it has been attributed to Fusarium cepae Hanzawa, as well as to Erwinia aroideae (Towns.) Holland.

Yellow dwarf or mosaic caused by Allium virus 1 is found.

PEACH (with Apricot and Cherry): Cladosporium carpophilum Thuem.; Mycosphaerella persicae Higg. & Wolf (under the imperfect stage Cercosporella persicae Sacc.); Cercospora circumscissa Sacc.; Coryneum carpophilum (Lév.) Jauch. (under the presumed conidial stage of Ascospora beijerinckii Vuill., only from the symptomatology of the disease); Gloeosporium

laeticolor Berk.; Cytospora sp.; Taphrina deformans (Berk.) Tul.; Tranzschelia prunispinosae (Pers.) Diet.; Nectria sp.; Monilinia laxa (Aderh. & Ruhl.) Honey (and other species?); fruit rot caused by undetermined species; Polystigma deformans Syd. (on Apricot).

Xanthomonas pruni (E.F.Sm.) Dowson is present on all Prunus cultivated species; Agrobacterium tumefaciens appears to be an uncommon species, also on peach trees. The identification of Erwinia amylovora (Burr.) Winsl. et al. is almost surely a misidentification.

Silver-leaf disease has been observed, with deficiencies of iron, potash, and phosphorus.

PEANUT: A bacterial wilt, both leaf spots caused by Cercospora arachidicola Hori and C. personata (Berk. & Curt.) Ell. are seldom present; Sclerotinia spp. (attributed either to S. arachidis Hanzawa or S. miyabeana Hanzawa) present as Botrytis spp.

PEAR: Armillariella mellea (Vahl ex Fr.) Karst.; Botrytis cinerea Pers. ex Fr.; Elsinoë piri (Wor.) Jenk.; Gloeosporium sp.; Glomerella cingulata (Ston.) Spauld. & Schrenk; Gymnosporangium haraeanum Syd.; Monilinia sp.; Physalospora piricola Nose. The most important disease appears to be the canker caused by Diaporthe ambigua (Sacc.) Nitschke. Erwinia amylovora (Burr.) Winsl. et al. has been identified in several localities.

Chlorosis due to an undetermined agent and little leaf or rosette has been observed. In many instances, also, the pitting of fruit is probably caused by boron deficiency.

PEPPER: Alternaria sp.; Cercospora sp. probably C. capsici Heald & Wolf; Colletotrichum sp. probably to be referred to C. capsici (Syd.) Butl. & Bisby (doubtfully distinct from the conidial stage of Glomerella cingulata (Ston.) Spauld. & Schrenk); Phomopsis vexans (Sacc. & Syd.) Harter (probably to be referred to P. capsici (Magn.) Sacc., conidial stage of Diaporthe phaseolorum (Cke. & Ell.) Sacc.); Verticillium albo-atrum Reink. & Berth.; Phytophthora sp., usually referred to P. parasitica Dast. (to be compared with P. capsici Leonian).

The presence of Pseudomonas solanacearum E.F.Sm. is uncertain; Xanthomonas vesicatoria (Doidge) Dowson is widespread; bacterial soft rot (Erwinia aroideae (Towns.) Holland) is rather common.

A mosaic and several other virus diseases are found.

Chlorosis has been found in many instances.

PERSIMMON: Botrytis cinerea Pers. ex Fr. on fruits; Cercospora sp. usually attributed to C. kaki Ell. & Ev.; Glomerella cingulata (Ston.) Spauld. & Schrenk, probably corresponding to Gloeosporium diospyri Ell. & Ev. (corresponding to G. kaki Ito ?); Mycosphaerella nawae Hiura & Ikata; Phoma sp. probably corresponding to P. diospyri Sacc.; sooty molds also determined as Capnophaeum sp.

Black-vein on leaves, caused by mineral deficiency, has been observed.

POTATO: Actinomyces spp., Alternaria solani (Ell. & Mart.) Sor.; Cercospora sp.; Fusarium spp.; Phytophthora infestans (Mont.) De By.; Rhizoctonia solani Kuehn; Sclerotium sp.; Spongospora subterranea (Wallr.) Lagh.; ? Synchytrium endobioticum (Schilb.) Perc. (to be confirmed); Verticillium albo-atrum Reinke & Berth.; Erwinia phytophthora (Appel) Holland and E. carotovora (L.R.Jones) Holland; Xanthomonas solanacearum (E.F.Sm.) Dowson.

Of the many virus diseases, simple mosaic (virus X), rugose mosaic, and phloem necrosis (Solanum viruses 1, 1 + 2, and 14) are the most important, probably also Solanum viruses 3, 12, and 15.

Black-heart, blackening, hollow heart, internal brown spot, tip-burn, etc., were indicated.

RICE: Root-rot caused by Achlya spp. and Pythium spp. were indicated; foliar and glume spots were produced by Cercospora oryzae Miyabe; Helminthosporium oryzae Breda de Haan (conidial stage of Cochliobolus miyabeanus (Ito & Kuribay.) Drechsl.); Phyllosticta glumarum (Ell. & Tracy) Miyabe, in addition to Piricularia oryzae Briosi & Cavara (it is uncertain whether Phyllosticta japonica Miyabe is different from P. glumarum); the foliar smut Entyloma oryzae Syd. appears to be a specialized form of E. lineatum (Cke.) Davis; bunt caused by Tilletia horrida Tak. (usually denominated Neovossia horrida (Tak.) Padw. & Khan); false smut produced by Ustilaginoidea virens (Cke.) Tak.; bakanae disease caused by Fusarium

moniliforme Sheld., conidial stage of Gibberella fujikuroi (Saw.) Wr.; root-rot produced by Hypochnus sasaki Shirai (Corticium sasakii (Shirai) Matsu.); Sclerotium oryzae Catt., an imperfect stage of Leptosphaeria salvinii Catt., and Sclerotium irregulare Miyabe related to Hypochnus sasakii are found; Helminthosporium sigmoideum Cav., imperfect stage of Leptosphaeria salvinii; Ephelis sp. The most important species from the economic point of view are Piricularia oryzae, the cause of the common blast, and Sclerospora oryzae Brizi (also as S. macrospora Sacc.).

Xanthomonas oryzae (Uyeda & Ishiyama) Dowson is quite common (East).

Virus disease producing dwarf or stunt is present (also on wild grasses) (Oryza virus 1). Just discovered is another virus disease, not yet studied, similar to a crinkle leaf (?) and not important from the economic standpoint.

Nitrogen and phosphorus deficiencies (sometimes attributed to iron deficiency) are quite common, especially nitrogen deficiency. Straighthead and other physiological abnormalities are found.

SESAME: Cercospora sesami Zimm. The bacterial spot (Pseudomonas sesami Malkoff) is very common, together with one or several capsule rots. Xanthomonas solanacearum (E.F. (E. F. Sm.) Dowson has been indicated.

One or two virus diseases were recognized.

SORGHUM (and allied species): Three smuts are the most important pathogens: in the northwest Sphacelotheca cruenta (Kuehn) Potter and S. sorghi (Link) Clint. and in the northeastern region S. reiliana (Kuehn) Clint. A Japanese flower-infecting smut, Ustilago Kaijana [? kenjiana Ito] is of increasing importance in Manchuria. Cercospora sp.; Helminthosporium sp. (probably H. turcicum Pass. or an allied species); Colletotrichum graminicola (Ces.) Wils.

SOYBEAN: Botrytis cinerea Pers. ex Fr.; Cercospora sojina Hara (C. daizu Miura; cfr. C. kikuchii Matsu. & Tom.); Diaporthe sojae Lehman (a variety of D. phaseolorum (Cke. & Ell.) Sacc. ?) of which only the imperfect stage (Phoma sp.) is known; Peronospora manshurica (Naum.) Syd. & Gäum.; Sclerotium sp. (= Sclerotinia libertiana Fuck.?).

Xanthomonas glycines (Nak.) Dowson (Bacterium sojae Wolf ?; to be compared with X. phaseoli (E. F. Sm.) Dowson var. sojense (Hedges) Starr. & Burkh.) is very common.

Two virus diseases are not common in the northeast: a yellow mosaic and a variable rugose mosaic.

A number of deficiency diseases are known. One peculiar disease, apparently not infectious, called "pod brown stripe", is known.

SUGARBEET: Cercospora beticola Sacc. is the most important disease; Fusarium spp.; Corticium vagum Berk & Curt.; Pythium spp.; Sclerotinia sclerotiorum (Lib.) De By.; Sclerotium rolfsii Sacc.; Phoma betae Frank, associated with heart rot.

SUGARCANE: Cercospora spp.; Colletotrichum falcatum Went; Corticium sasakii (Shirai) Matsu.; Gibberella fujikuroi (Saw.) Wor. (supposed), conidial stage (Fusarium moniliforme Sheld.), in the "pokkah boeng" disease; Gnomonia iliau Lyon; Helminthosporium spp.; Leptosphaeria sacchari Breda de Haan; Melanconium sacchari Massee apud Speg.; Ustilago scitaminea Syd. or allied species.

Bacterial red stripe (Xanthomonas rubrilineans (Lee) Starr. & Burkh.) is localized and unimportant.

The mosaic disease (Saccharum virus 1) is very common, together with several deficiency diseases.

SUNFLOWER: Botrytis cinerea Pers. ex Fr; Erysiphe cichoracearum DC.; Septoria helianthi Ell. & Kell.; Puccinia helianthi Schw.

SWEETPOTATO: Actinomyces spp.; Albugo sp.; Ceratostomella fimbriata (Ell. & Halst.) J. A. Elliott; Cercospora sp. (probably C. batatae Zimm.); Fusarium batatatis Wr.; Monilochaetes infuscans Ell. & Halst.; Pythium spp.; Rhizoctonia solani Kuehn; Rhizopus sp.; Sclerotium bataticola Taub.; Sclerotium rolfsii Sacc.

A disease allied to curly top (Beta virus 1) is found.

A number of deficiency diseases, not yet distinguished, were observed.

TEA: Gloeosporium theae-sinensis Miyabe; Macrophoma theicola Petch; Phyllosticta theaefolia Hara; Exobasidium vexans Massee (common during the rainy season, to be compared with E. reticulatum Ito & Saw. from Japan); Capnodaria theae Hara; root rot by several fungi. On the leaves the alga Cephaleuros virescens Kunze has been observed.

The bacterial leaf spot (Bacillus theae Hori & Bokura) is a doubtful species, in any case uncommon.

A number of deficiency diseases, not yet studied, were observed.

Leaf variegation with partial albinism (similar to the symptomatology on Camellia) is present, as well as silver leaf.

TOBACCO: Cercospora nicotianae Ell. & Ev.; Colletotrichum destructivum O'Gara; Fusarium nicotianae J. Johnson; Phytophthora parasitica Dast. var. nicotianae (Breda de Haan) Tucker; Pythium spp.; Sclerotium rolfsii Sacc.; Thielaviopsis basicola (Berk. & Broome) Ferr.; Pseudomonas angulata (Fromme & Murray) Holland; P. tabaci (Wolf & Foster) F. L. Stev.; probably also Xanthomonas solanacearum (E. F. Sm.) Dowson.

Many virus or virus-like diseases were found, the commonest being both mosaics (Nicotiana virus 1 and Solanum virus 2) and ringspot (Nicotiana virus 12).

Also, deficiency diseases are of common occurrence.

TOMATO: Alternaria solani (Ell. & Mart.) Sor. and probably other species; Botrytis cinerea Pers. ex Fr.; Cercospora spp.; Fulvia fulva (Cke.) Cif. (under Cladosporium fulvum Cke.) not rare in the southern regions; Colletotrichum phomoides (Sacc.) Chester and C. nigrum Ell. & Halst. (or C. atramentarium (Berk. & Br.) Taub.); Fusarium lycopersici (Sacc.) Wr. and Fusarium spp.; Glomerella cingulata (Ston.) Spauld. & Schrenk; Rhizoctonia solani Kuehn; Phoma destructiva Plowr. (from the appearance of the market fruit); Phytophthora spp.; Pythium spp.; Rhizopus stolonifer (Ehr. ex Fr.) Lind. (R. nigricans Ehr.); Verticillium sp.

Corynebacterium michiganense (E. F. Sm.) Jens.; Xanthomonas vesicatoria (Doidge) Dowson and X. solanacearum (E. F. Sm.) Dowson.

Many virus diseases are found in continental China, but only fernleaf virus (Cucumis virus 1), mosaic (Nicotiana virus 1 or ? potato virus 1), and spotted wilt (Lycopersicon virus 3), are identified.

Of the nonparasitic diseases blossom-end rot, core rot, frenching (a phase of fernleaf?), leafroll (virus?), and sunscald are the commonest. Nitrogen deficiency is common.

TREES (general, mostly ornamental): Armillariella mellea (Vahl ex Fr.) Karst.; Rosellinia spp.; Helicobasidium mompa Tanaka; rots caused by Hymeniales. Dodder (Cuscuta japonica Choisy) is not rare, on wild plants, as well as several mistletoes (Phoradendron spp.; Loranthus spp.; Viscum spp.). Algal leaf spot (Cephaleuros virescens Kunze) is not rare in the South[2].

WHEAT: Claviceps purpurea (Fr.) Tul.; Erysiphe graminis DC.; Fusarium spp. including Gibberella zeae (Schw.) Petch, probably also G. fujikuroi (Saw.) Wr.; Helminthosporium spp. commonly indicated as H. gramineum Rabh., but probably H. sativum Pam., King, & Bakke, also under the binomial Cochliobolus sativus (Ito & Kuribay.) Drechsl.; foot rot of which the pathogens were apparently not yet determined; Pythium spp.; Sclerospora macrospora Sacc.; Septoria spp.; Tilletia caries (DC.) Tul. and T. foetida (Wallr.) Liro; Tuburcinia tritici (Koern.) Liro; Ustilago tritici (Pers.) Rost.; Puccinia glumarum (Schm.) Erikss. & Henn.; P. graminis Pers., and P. rubigo-vera (DC.) Wint.

Xanthomonas translucens (L. R. Jones, A. G. Johnson, & Reddy) Dowson and X. tritici (Hutch.) Dowson.

One or more mosaic viruses, including rosette virus, are found.

The nematode disease is very common.

MISCELLANEOUS PLANTS: Dodder, conventionally determined as Cuscuta japonica Choisy but really composed of several subspecies, is very common on trees, shrubs, and herbs. Nematodes are very common.

---

[2]Attention should be called to an Endoconidiophora bunae Kitashima, described in 1936 on Fagus cruenta Blume, which from the description is allied to species of Chalara and related genera parasitic on Fagaceae.

Acknowledgment

In conclusion, I am indebted to Dr. G. C. Ainsworth for revision and criticism of this paper.

Literature Cited:

1. DARKER, G. D. 1940. A brief host index of some plant pathogens and virus diseases in Eastern Asia. Plant Dis. Reptr. Suppl. 122: 93-123.
2. LING, L. 1948. Host index of the parasitic fungi of Szechwan, China. Plant Dis. Reptr. Suppl. 173: 1-38.
3. SIANG, W. N. 1952. Host index to non-fungus diseases of plants in China. Plant Dis. Reptr. Suppl. 215: 165-186.
4. TAI, F. L. 1936-1937. A list of fungi hitherto known from China. Parts I, II, III, and IV. Sci. Rept. Tsing Hua Univ., ser. B. 2, pages 137-165, and 191-639.

BOTANICAL INSTITUTE AND GARDEN, ITALIAN CRYPTOGAMIC LABORATORY, THE UNIVERSITY, PAVIA, ITALY

A CORRECTION

C. E. Yarwood sends a corrected copy of the references to his paper on virus S (Reporter 39: 622. 1955). The references should be as follows:

1. Rozendaal, A. 1954. De betekenis van verschillende virusgroepen voor de teelt van pootgoed. Landbouwvoorlichting 11: 299-308. 1954.
2. De Bruyn Ouboter, Maria P. 1951. A new potato virus. Proc. Conf. on Potato Virus Diseases, Wageningen-Lissee, 13-17 August.

RESULTS OF THE 1954 FUNGICIDE TESTS

"Results of 1954 Fungicide Tests" reprinted from a series of articles appearing in Agricultural Chemicals, April through June, may be purchased in bound and covered form for $1.00 per copy by sending orders with remittance to Dr. D. A. Roberts, Department of Plant Pathology, College of Agriculture, Cornell University, Ithaca, New York. The publication of these results is under the sponsorship of the American Phytopathological Society. It is a continuation of the publication of results formerly provided through a Supplement of the Plant Disease Reporter, Plant Disease Epidemics and Identification Section, U. S. Department of Agriculture.

The Temporary Advisory Committee on Collecting and Disseminating Data on New Fungicide Tests of the American Phytopathological Society arranged for the recent publication of data and the continuation of a program for annual publications of Fungicide Test Results in the future. Dr. D. A. Roberts, Department of Plant Pathology, Cornell University, Ithaca, New York, will be in charge of this project during the current year.

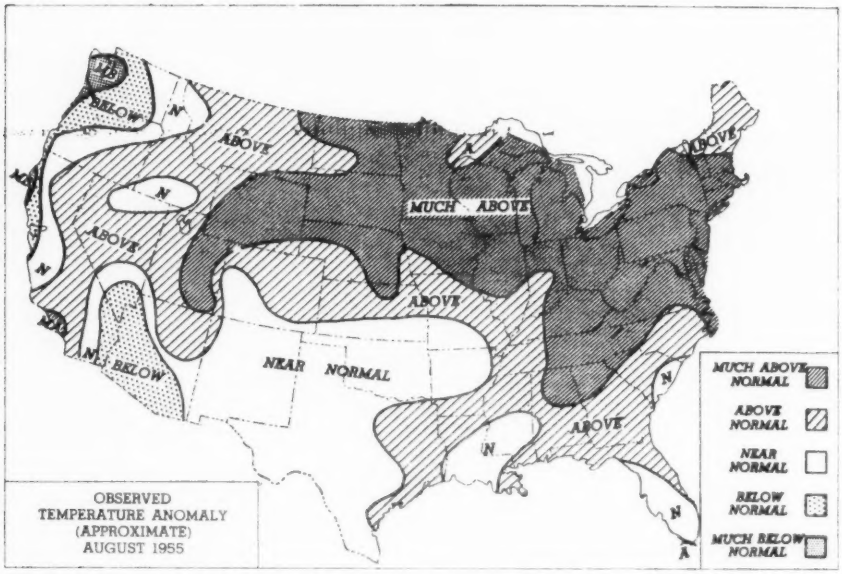
A COMMITTEE ON THE HISTORY OF PLANT PATHOLOGY

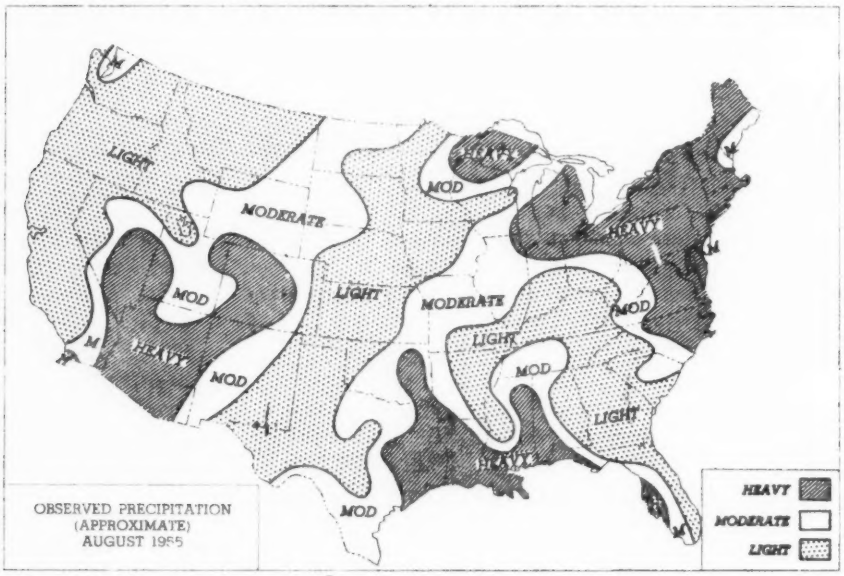
The American Phytopathological Society, at the Estes Park Meeting in August 1954, appointed a standing committee on the history of plant pathology. The function of this committee, as clearly stated in the instructions received from the Council of the Society, was not to write a history of plant pathology but to collect and conserve items of historical significance to the science of plant pathology. With this understanding the committee has set up a file which for the time being is being maintained by The National Fungus Collections at the Plant Industry Station, Beltsville, Maryland. In this file there is being placed reprints, photographs, and documentary materials of all kinds bearing on the subject. To date we have received interesting items from Drs. E. L. LeClerg and Max W. Gardner and have on hand for inclusion papers from the C. L. Shear collections dealing with the founding and early years of the Society. Dr. Curtis May has made available accumulated secretary's records for a number of years. Unfortunately, it is known that earlier Society records were discarded from time to time.

The Committee requests that members having material of significance send it to the undersigned for inclusion in what should become to all intents and purposes the Archives of the Society.

John A. Stevenson
Chairman

THE NATIONAL FUNGUS COLLECTIONS, PLANT INDUSTRY STATION, BELTSVILLE, MARYLAND





The terms used in the accompanying maps, which define the ranges of temperature and precipitation, are numerical class limits. These are based on a statistical analysis of past records through which is determined the normal frequency of occurrence of temperatures and precipitation at various times of the year for different locations. For temperature the classes above, below, and near normal are so defined that they each normally occur one-fourth of the time; much above and much below normal, one-eighth of the time Precipitation is depicted in terms of light, moderate, and heavy, each class normally occurring one-third of the time and thereby having equal probability of occurrence. These maps graphically represent only the general trends and give the country's weather picture at a glance. For quantitative studies, where monthly mean temperatures and actual precipitation records are needed for a given time and place, other publications of the Weather Bureau should be consulted. P. R. M.

MANUSCRIPTS FOR THE PLANT DISEASE REPORTER

(See also PDR 35: 121-122; 36: 214, 494)

(1) GENERAL: The Reporter page measures 9 inches long with the heading or 8 3/4 inches for the text part, by 6 inches wide. The copy is typed on a larger page, 11 1/4 inches of text or 12 inches overall in length by 8 inches in width, and reduced 25 percent in the photographic process of reproduction. Illustrations or tables larger in either dimension will take a correspondingly greater reduction. Only one size of type is available for text, footnotes, or tables.

(2) MANUSCRIPTS should be the original ribbon copy, not carbons, clearly typed and double-spaced throughout, including tables, footnotes, and bibliographies. (Note -- only one copy is needed.) Footnotes should be typed at the bottom of the page.

(3) ABSTRACTS are requested for all except very short articles. (PDR 38: 316).

(4) CAUSES OF DISEASES should be named. For bacteria, fungi, nematodes, etc., give the Latin name of the organism; for viruses either or both the accepted common name of the virus or a Latin name if you prefer it and there is one; for non-parasitic diseases state the causal factor if it is known. If the cause of a disease has not been determined say so. (PDR 36: 494).

(5) LITERATURE REFERENCES should be given in alphabetical order and numbered for citation in the text. We follow the AIBS suggestion of placing the year of publication after the author's name. Please check your titles carefully since we cannot do it for you. Be sure that text citations and bibliography agree; that foreign-language references are correct; that number or month is cited for periodicals that are not paged consecutively throughout the volume.

(6) NAMES OF FUNGICIDES should be given according to the suggestions that will be published in Phytopathology before long, and later repeated in the Reporter. In the meantime see PDR 35: 122.

(7) ILLUSTRATIONS should be sent to us unmounted. To prevent mistakes, write figure numbers on the back, and mark the top of each print when necessary. A sketch can show a preferred arrangement but please keep in mind page size, shape, and standard reduction (see above under General), and remember that figure titles and legends are part of the page. Lettering should be clear and large enough to be legible after reducing. Drawings, maps, and graphs can be photographs or originals, but should be finished and ready for reproduction, not just sketches.

(8) TABLES should be carefully thought out with particular attention to the Reporter's limitations in reproduction. Make titles and headings definite and self-explanatory. Designate footnotes in tables with superscript lower-case letters. Be sure that text discussion agrees with the data in the table. Do not abbreviate names of crop varieties.

(9) REPRINTS cannot be supplied since there is no way in which we can be reimbursed. However,

(10) The MULTILITH PLATES from which reprints can be made will be sent if requested at the time the article is submitted. The press size of these plates used for the Reporter is designated as small -- maximum image 9 1/2 by 13 inches, maximum paper size 9 3/4 by 14 inches -- for Model 1250. Most of the Experiment Stations have this type of multilith machine.

(11) We are the official correspondents in the United States of the PLANT PROTECTION BULLETIN published monthly by the United Nations Food and Agriculture Organization. We would appreciate it if plant pathologists would send us suitable material from time to time for inclusion in our monthly summary reports. Please mark it clearly so that we will know it is intended for the Bulletin. (See PDR 36: 492; 37: 637) -- P. R. M.